ELECTRICAL REVIEW

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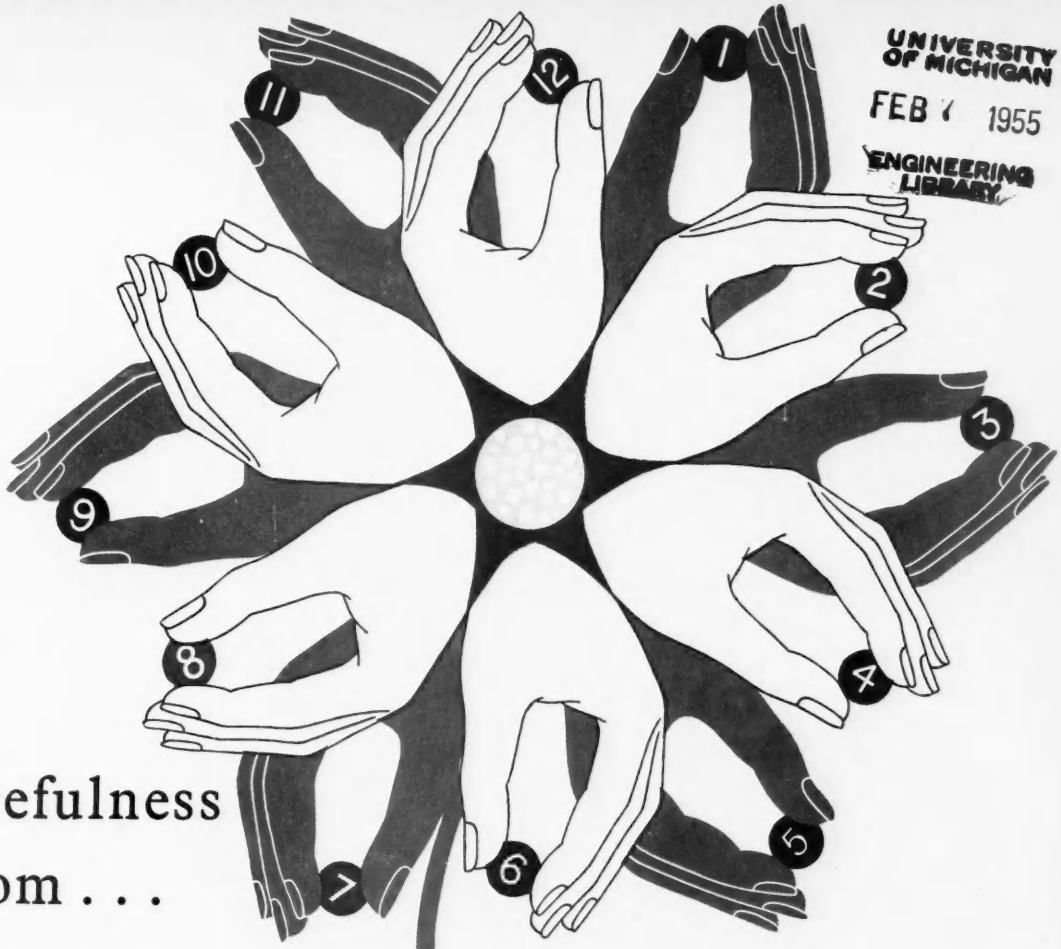

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ELECTRICAL REVIEW

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14 JANUARY 1955

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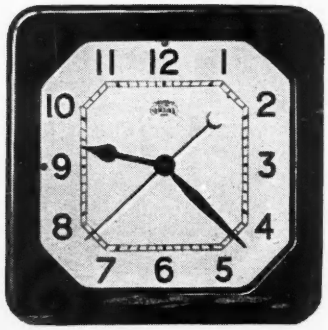

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ELECTRICAL REVIEW

14 January 1955 Vol. 156 No. 2 Established 1872

Nuclear Energy and Electricity

WE in this country have known for a long time that there was a limit to the extent of our main source of energy, coal, in terms of a few generations, but there has been a tendency to hide behind the " Maginot line " of false security or ignorance. It was perhaps natural that the possibility of the use of nuclear energy was hailed as something that would solve an immediate emergency in the form of fuel or energy shortage by a sort of overnight change–over.

But the lapse of time since the first announcement about the use of atomic energy has moderated the wilder outlook in regard to the new development, and we think the time has come for a definite effort to be made to put things relating to electricity supply in their truer perspective. If we hark back to the theory of common matter being composed of the elusive atom or " electric force " made up of protons, electrons and the like, we see normal " conducted " electricity, electronics and nuclear energy, all on the common platform of electrical science in which are the roots of electrical engineering. This has led to the belief, even within the electrical industry, that in the generation of electricity from nuclear energy there will be some sort of direct conversion. While there is something logical in thinking that this should be so, the only known possibility of generating electricity for nuclear energy on an appreciable scale is by the transfer of heat from the nuclear reactor to a form of boiler for steam raising and then by the normal driving of electricity generators by the heat engine.

In his article in the *Electrical Review* of 23rd April, 1954, Dr. S. G. Bauer, then with the Atomic Energy Research Establishment, Harwell, made it clear that the commercial production of electricity from nuclear fission was not a problem that had already been solved, and that three outstanding difficulties were capital cost, safety to operatives and indeed to the general public, and thermal efficiency. So far we have not been able to obtain any reliable information as to the cost involved in building and installing nuclear reactors, except that it is at present probably commercially exorbitant. It has already been shown that with great difficulty, which experience will certainly lessen, the safety problems can be overcome by such means as isolation and remote control. Finally, by comparison with the heat transfer in a normal coal-fired power station, the thermal efficiency of nuclear energy production of electricity is very low. The steam conditions appear to compare with those in force in this country forty or so years ago, while the boiler or steam generator employed is rather like a present-day waste-heat boiler. But despite all this we face the issue with every confidence that all these difficulties will be solved during what must essentially be the gradual change-over from coal to nuclear energy.

EXPORT PROSPECTS

Official surveys of overseas markets for British manufacturers are easily available. As a rule these deal in a general way with the characteristics of the countries concerned and the prospects for exporters of broad classes of goods. There is a lack of data about the scope for particular industries, especially the electrical. In an endeavour to help fill this gap we have commissioned a series of articles from qualified writers in a number of countries. These will review conditions from an electrical point of view and indicate the possibilities of selling British electrical plant and equipment. Guidance will be given upon methods of approach, representation, and other relevant matters. The first of the series, published in this issue, covers trade with Canada. The author, Mr. R. C. Golding, is an Englishman who has been in Canada long enough to get the " feel " of the market and acquaint himself with the requirements, predilections and, maybe, prejudices of the Canadian buyer. The second article in the series will be on India and will be published in next week's issue.

HOUSE IMPROVEMENT GRANTS

Opportunities for electrical contractors are presented by the Government's scheme of grants for the improvement of houses and the conversion of non-domestic buildings into houses. The scope of the scheme is indicated in a booklet issued by the Ministry of Housing and Local Government reviewed in this issue. Landlords are advised to seek the guidance of a " competent electrician " when the improvement of the electrical equipment of a house is being considered. There are some limitations in the plan which we consider to be unjustifiable. For instance, we question the statement that " where cooking is done by gas or electricity a solid fuel appliance is usually desirable for space heating and hot water." Although it may be true that " a movable gas or electric cooker is normally provided by the tenant," it is a common practice in municipal houses, at least, for the landlords to provide cookers. Therefore it may be unfair to exclude appliances of this kind because they are movable. We are glad to find the Ministry favouring an adequate number of socket outlets for we remember a dictum of the Ministry of Works some time ago that these should be as few as possible.

THE STAFF PROBLEM

Much has been said and written, particularly during the last year or so, about the very real and desperate shortage of professionally qualified people in industry. The blame, if it can be called that, has been suggested to lie in various quarters, but in spite of all efforts to improve matters many firms are finding it increasingly difficult to secure newly qualified men and those with a few years of specialized experience. It is true that the facilities for teaching engineering and allied scientific subjects are far from adequate in some of our universities and technical colleges, but new buildings are being erected and a great deal of reorganization is taking place. No matter how many improvements are made it is unlikely that an ideal state will ever be reached since even now not enough young men are forthcoming to fill the places which are available. One reason for this is the shortage of science teachers in schools. Recruits can only be attracted to scientific and engineering careers by the creation of the right attitude of mind at an early age. Although much can be done by the science teachers it is not really the answer. Parents have the greatest influence over children and it is surprising that no public appeal has been made now that we have in our hands such a powerful instrument of publicity as television. Many films directed at potential employees have been made by industrial organizations for showing in universities and technical colleges and there seems to be no good reason why they should not make other films directed at parents and children for showing on television.

RAILWAY IMPROVEMENT

Saved from the disastrous consequences of a railway strike by wage concessions to the railwaymen, the country still has to learn how the extra burden is to be met by the British Transport Commission. It seems to be accepted that some form of State assistance or subsidy is unavoidable but at the same time there is a realization that the present structure and operation of the railway system are not all that they should be. It is this realization that prompted the Government to instruct the Commission to prepare a comprehensive development plan which was supposed to have been presented to the Ministry of Transport by the end of last year. Details of the plan are expected to be made public shortly and it is permissible to forecast that they will include a wide extension of electrification. But apart from traction, there are many other directions in which electricity can help to raise the efficiency and acceptability to the public of the railway services, e.g., in goods handling and the modernization of stations. There should be much of interest to the electrical industry in the plan.

COAL SITUATION

Despite increased mechanization the output of coal in 1954 rose by only 270,000 tons to a total of 223·8 million tons. Nevertheless the small increase was obtained by fewer men at the coal face. During the year the coal consumption of the British Electricity Authority rose by 3 million tons, although, as the National Coal Board says, this was a million tons less than it would have been if the B.E.A. had not improved generation efficiency. Altogether inland consumption in 1954 was 6 million tons higher and it was necessary to provide for further imports of coal. Distributed stocks at 31st December last were 1·7 million tons less than they were a year earlier. As is known, the B.E.A. is helping to meet the coal shortage by using oil fuel at some of its stations. In two or three years' time small quantities of power from nuclear reactors will become available. But coal must still remain the prime fuel for many years and the B.E.A. will be looked upon as a principal customer for the rising proportion of fine coal which results from increased mechanization.

WORLD ELECTRICAL MARKETS

Trade with Canada

By R. C. GOLDING (Toronto)

I HAVE been asked for a short account of the Canadian view of a British problem, which can be summed up in two short words "Canadian Trade." I am going to assume that the acquisition of dollars is as important to the British manufacturer to-day as we are assured in Canada it is regarded by the British Government. Most of my remarks will be addressed to the manufacturer; without his goodwill, his intense desire to co-operate, they will fall on barren ground.

This problem of Canadian-British trade is not a simple one. There is no direct solution, or no obvious one, involving as it does the United States, as well as those more intimately affected. This is just as true of the economic tangle in which we find ourselves to-day, as it is of our military situation.

One point stands out, and should be stressed. Making the assumption I have outlined above, then on both sides of the Atlantic there is the same conviction, that somehow, in some way, the solution to British as well as Canadian problems lies to a large extent in inter-trading. Let this not be doubted for a moment: there is a very real and intense pro-British sentiment in Canada. But nobody should think that he can sell to Canada on sentiment.

This increased inter-trading may eventually be brought about in many ways, or it may never come to pass. It may be facilitated by tariffs, Commonwealth preference, or by free trade. On this point there is no agreement, and certainly no universal panacea.

This is in spite of many anti-British expressions of opinion, and what may be regarded as anti-British acts. In reality these are no more anti-British than Britain's act in purchasing wheat from Russia is anti-Canadian; they are merely expressions of Canada's intense individuality.

In taking a view of the Canadian scene, it is necessary to keep this individuality very much to the forefront of one's mind. A number of American business men have recently been making speeches which seem to indicate a belief that Canada is the U.S.A. of the future. Canadians as a whole are sure that the only thing which will prevent such a state of affairs from coming to pass, will be the inability of the country to support a population necessary to develop to that extent. The future has always outstripped man's imagination, and Canada's part in the future of the New World is going to be a very large one indeed. With this in view the United States is investing capital in Canada at a tremendous rate.

I hope I have made my first point, that Canada is rapidly coming to be a force to be reckoned with, and that as such its markets are valuable to any country which can, with dignity, help to satisfy them. Before we can proceed to a recital of how this can best be brought about, it is necessary to understand a little of the internal problems of Canada. To this end, let us deal with the subject under a number of heads.

Fish and Wheat.—The trading situation in fish and wheat is one which inspires leading business men in these industries to call, and to call loudly, for increased trade with Britain. The lack of dollar exchange in Britain has hit no section of Canada harder than the fisheries of British Columbia, and the wheatfields of the mid-west. It is unfortunate that the largest section of all the products in the far west, that of forest products, newsprint, pulp, and building materials, are similarly situated. Here then

The works of Ferranti Electric, Ltd., Toronto. The buildings in the centre are the main transformer factory, and the main office building, which also includes the meter and X-ray divisions. In the foreground is the new ordnance and research building

we see three great industries crying out for trade with Great Britain. Commenting on a recent large order for electric cables placed by the B.C. Electric Co. with a British company, Mr. H. R. MacMillan, a Canadian industrialist with far west connections, is reported to have said " the lumber and fishing industries of British Columbia are delighted to learn that the B.C. Electric has bought electric cables from the United Kingdom."

This then is the outlook of the west of Canada, expressed as succinctly as the outlook of any great mass of population can be expressed. It is obvious that in the west British goods are welcomed as providing an outlet for Canadian development. These goods might take the form of invested British capital; developments in this respect have already taken form in respect of the industrial development of an island in the Fraser River. We have already noted the influx of American capital into Canada. Here we see the possibilities of Great Britain taking action along these lines, with good results, in the main, to British Columbian exports. Let us now bear both these aspects in mind while we turn to the east of Canada, and the manufacturing areas.

Manufacturing.—The reaction of the manufacturing areas of Canada to the above arguments, is both immediate and determined. The viewpoint of the Canadian Electrical Manufacturers' Association is epitomized by Mr. H. H. Rogge, president of Canadian Westinghouse, who announces 680,000 man-hours lost to Europe recently in the way of orders for electrical equipment. It is significant, from the Canadian point of view, that some of this equipment is specified to be the exact duplicate of that previously manufactured in Canada. For the moment it is only the companies who are raising the cry that work is being taken from Canadian hands. Before long it may be the unions, then it is fairly sure that the Government will take action. At the moment it is not anticipated that a solution can, or ought, to be found in increased tariffs. However, some kind of selective treatment is advocated, so that turbines which are not manufactured in Canada might be allowed in, but transformers, competing with home products, excluded.

International Exchange. — A certain amount of piquancy is added to this situation developing among the manufacturers, particularly electrical manufacturers, by the fact that some of the representatives of big business are agitating for more trade with Great Britain. A situation has occurred within the last few months, where a company president has made an announcement condemning bitterly the inroads being made by Great Britain and Europe into Canadian trade. From this he has returned to his desk, to find a circular there, from a fellow manufacturer, asking him to make more purchases in the sterling area.

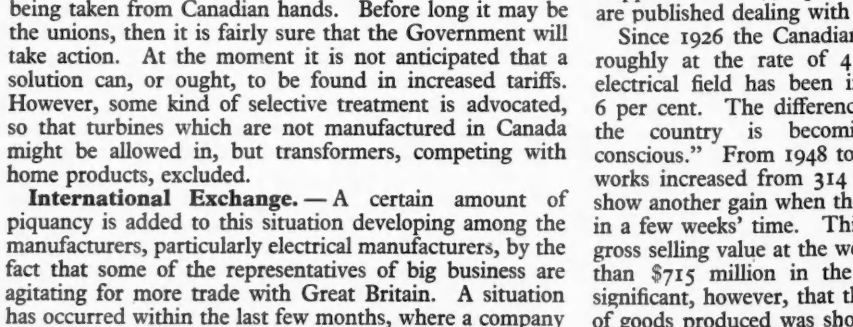
This situation has arisen from the monetary exchange position. The Canadian Government is reputedly sensitive to the farming vote, and is reluctant to enforce anti-dumping legislation which exists. Be this as it may, the electrical industry in Canada is openly asserting that Great Britain and Europe possess 50 per cent of the electrical market in many lines. And still Britain is too short of dollars to buy the newsprint and wheat Canada would like to send her.

The pro-British section of Canadian industry (those that are not feeling the competition) and of course the middle west, point to the currency out-of-balance which exists between the United States and Canada. During 1953 Canada sold to Great Britain $214 million more goods than she received from Great Britain. However, we received from the United States $766 million more goods than we sent them. Canada bought from the U.S.A. more than seven times the amount of goods that she bought from Britain. This is in spite of preferential tariffs, and the open door available to British salesmen, if they can take advantage of it at the right price. The reasons for this state of affairs are many, only some of which are under the control of the British manufacturer. Many American firms have started associated companies in Canada, where American parts are assembled or used in part manufacture. In some instances mass production in the U.S.A. enables them to undersell all other competition, even after paying import duty. Other matters could be improved from the British angle and these will be mentioned in the next section.

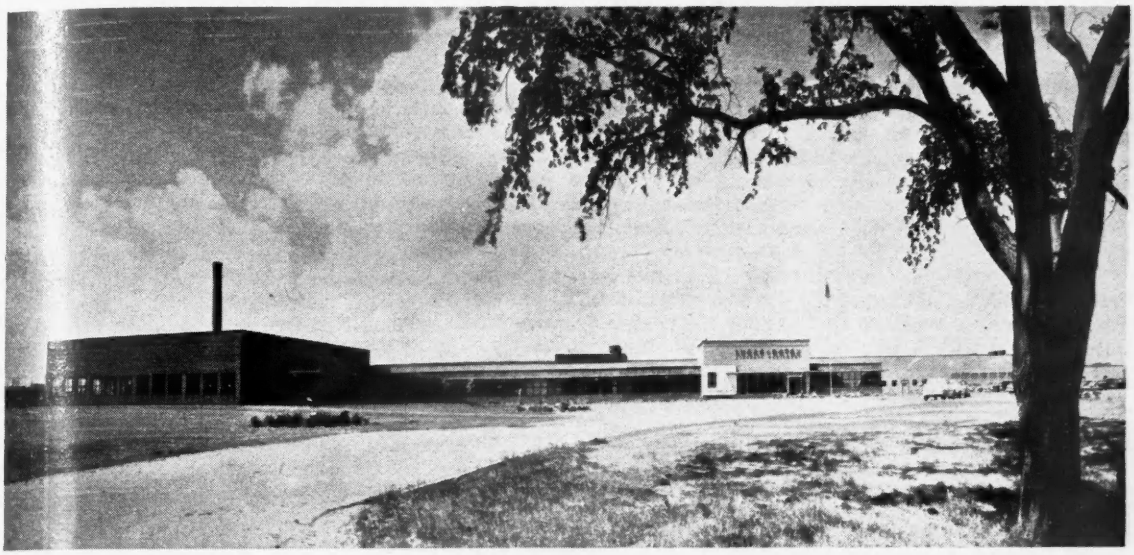
Those who wish to review the position in terms of dollars, can best do so through the publications of the Dominion Bureau of Statistics, Ottawa. The most revealing work is entitled " The Electrical Apparatus and Supplies Industry," published annually. Similar works are published dealing with the import and export fields.

Since 1926 the Canadian economy has been increasing roughly at the rate of 4 per cent compounded. The electrical field has been increasing at the rate of some 6 per cent. The difference represents the rate at which the country is becoming increasingly " electricity conscious." From 1948 to 1952, the number of electrical works increased from 314 to 401, and this will certainly show another gain when the 1953 figures become available in a few weeks' time. This represents an increase in the gross selling value at the works from $425 million to more than $715 million in the same period. It is possibly significant, however, that the annual increase in the value of goods produced was showing a 15 per cent increase in 1948–49. In 1951–52 this figure was nearer 6 per cent, while inventory values of goods stocked were rising slightly.

There is a feeling of optimism to be noted among those responsible for large scale planning in the industry, although they do not hesitate to emphasize the problems introduced by foreign imports. Spokesmen suggest that the larger



The works of D. M. Fraser, Ltd., who have come to an arrangement with J. G. Statter & Co., Ltd., to use imported air and oil circuit breakers in " dead-front " switchboards, popular in Canada



Lucas-Rotax, Ltd., found that their increasing commitments in Canada involved setting up manufacture in Toronto

organizations are planning their extensions roughly in step with the anticipated rise in the country's economy. This means that the proportion of the demand going to Canadian manufacturers, if their plans mature, will not fall. At the same time, because of the country's rapid expansion, it means that imports should increase. This is doubly true if account is taken of the goods included as " manufactured in Canada," but which incorporate imported parts.

It has been shown that if Canada diverted only 7 or 8 per cent of her U.S.A. import trade to Britain, Britain's trade deficit would be wiped out, and that is the prize which is open to British trade to-day. However, to avoid repercussion in Canada, these imports must be channelled into lines which are not made to any great extent in that country, or must replace American imports to some extent. If Britain can sell any more than this quota, then the extra might well become capital investment in Canada. It is understood in Canada that the major obstacle to the whole procedure is that Great Britain has an insufficient surplus to make capital investment possible.

Marketing Methods.—It is at this point then that we should face one remaining question. Granted that the British manufacturer is ready and willing to make every effort to redress the situation, how should he set about it? What factors are working against him in Canadian markets? My first suggestion to a British manufacturer would be " Make up your mind if you want to be in this business up to the hilt; if not then keep out of it." Numerous firms have made half-hearted attempts at the market, and then dropped out. And it needs three sound business offers to remove the bad taste left by one defaulter.

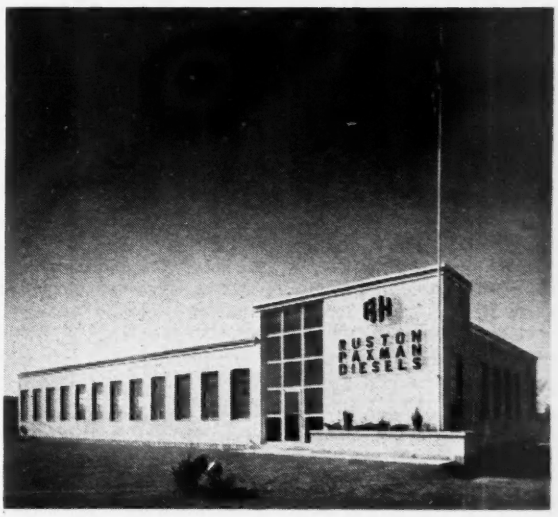
The best method of procedure is now becoming somewhat stabilized. Wherever the product suits this treatment, it appears sound to first set up agencies, then to erect an assembly plant, and when this is established, to develop into full-scale production in Canada. The last step may possibly have to be modified in the instance of parts requiring expensive tooling.

This I would emphasize, whether an agency is created or salesmen sent out, the necessity to choose a good man, and to be prepared to carry out his recommendations. In a number of instances a salesman has recommended that certain goods are not suitable, but his advice has been over-ridden by the directors at the British end. Do not depend on the British, or even possibly Australian, reputation of an article to sell it in Canada. Canadians are not waiting open-handed to receive British goods on a second-hand reputation. Canadians know what they want, and will go where they can get it.

One further question which may be asked is: Which industries have the best prospects in Canada, and what procedure is best calculated to succeed? Undoubtedly the answer to the first question is the simpler. Consultation should be undertaken with one or other of the offices of the British Trade Commissioners, where much valuable advice may be had for the asking. Among other literature will be found lists of industries in which a Province is lacking. Experiences of those who have previously established, or tried to establish, a particular line are almost certain to be available.

In considering this aspect, it should be realized that there are a large number of British firms, as distinct from British industries, which have no place in the Canadian

Ruston & Hornsby, Ltd., are chiefly engaged in importing heavy plant manufactured in Great Britain



market, under the guise in which they exist to-day. I refer here to the smaller manufacturer in many cases, to those who have always been classified in the author's mind as the "Birmingham type." Having been brought up in Birmingham, I might add that in that description is meant no disparagement of that great city, it is used rather to describe a number of satellite industries. Those in mind are the ones which have grown piecemeal, usually without any specific planning, to feed a demand fostered by the larger firms, or encountered from a restricted locality or section of the population.

These companies have a product to sell, it is a good product, it meets the need of the demand created for it. It may be a coffee pot, or an electric iron, or a blow lamp, but because it sells in Britain is no reason at all why it should sell in Canada. It might quite well be found to be useless to say "Here is an iron, it is a good iron at a low price, it has been tested well in a critical market, and it will outlast any iron you may find to compete with it." In Canada they sell British lawnmowers, but they sell them without grass deflectors or grass buckets. These may be advantages which are plain to the British eye, but the fact is that in Canada you welcome the grass shooting out backwards over your shoes as you walk.

To what extent is Canada prepared to take those goods she wants from Britain? Here we encounter the aftermath of some of the subjects discussed earlier. In the electrical industry, Canadians will buy and are buying, otherwise the remarks of the C.E.M.A. would not have been made. And these goods will to a large extent be in competition with goods manufactured in Canada and the United States. In many lines it will prove difficult to compete with the latter; competing successfully with the former may not always be popular.

United States Competition

Competing with the States, even with a price advantage, may be difficult in some instances because of the numerous branded lines which Canada and the United States have in common. Many industries started in the United States are now established in Canada, but vital parts are still imported. The importation of diesel engines for locomotive building is a case in point. However, this can be arranged with Great Britain too, as in the instance of h.r.c. fuses. Canadian firms are buying British circuit breakers, and including them in locally built switchboards. To such instances we can add the importation of steam and gas turbines. Here we are dealing with products which are not manufactured in Canada at all, there being practically a clear field, and the record shows that Canada is willing and anxious to buy British. In a choice of products those favoured would appear to require the maximum labour as compared with material, and the minimum ship storage space.

There is one field of which Britain has touched only the fringe. This is the highly specialized machine or process, which even to-day has received little publicity among Canadian business men. This may be a process for heat treatment, it may be a TV camera, or as in an instance encountered recently, a method of spraying cement. Many firms have already broken into this field by accident, but the number is small compared with the opportunities which exist.

One company has successfully introduced a baking oven generally acknowledged to be superior to anything on the North American continent for one special purpose. However, although it has been in production in Britain for many years, it was only due to an accident that the possibilities were realized in Canada. Since this occurrence it has also met with a good measure of success in the United States.

If Canadian engineers know little about a particular line or process of this nature, the fault must obviously lie at the door of the British sales organizations. Germany is at the moment experiencing a measure of success with a type of potato peeler, and, so far, no one knows whether it is made in Britain or not.

Some advice might perhaps be given on the subject of costs. About advertising costs it may briefly be said that advertising on the British level, on the appropriations common in Great Britain, will hardly suffice for Canada. On expenses and commission rates, at the risk of being repetitive, I would mention the story of the salesman in Vancouver who received a request from England to close a sale in Nova Scotia. He wired back "You do it, you are nearer." There is little doubt that the problem of the costs incurred in maintaining manufacturer-customer relations in Canada, is but little understood in British industry.

Debate Recording Installation

THE House of Assembly of the Western Region of Nigeria will shortly have an up-to-date method of recording its debates. To overcome the difficulties of language and dialect the Crown Agents decided on a tape recording system and unique equipment has been designed and built by Electric & Musical Industries, Ltd.

A single console houses all the microphone controls, amplifiers and power supply units. On the control desk there are seven microphone switches on an outline floor plan of the House in the positions corresponding to the seven fixed microphone positions. There are also five spare microphone inputs. As Members of the House rise to speak the operator, watching through the window of his sound-proof control room, has only to switch in the appropriate microphones. The technical operations of mixing and controlling volume levels are performed automatically.

From the operating console the speech is fed to four type TR.50 tape recorders in the recording room and at the same time the microphone outputs are fed through separate amplifiers to 12 headphone sets in the press gallery. The 12 microphone outputs are fed to 12 pre-amplifier units rack-mounted in the right-hand cubicle of the console. The outputs from the pre-amplifiers are taken to 12 rotary key switches mounted on the desk top, and then to a resistive mixing pad, after which the composite signal is taken to a line compressor unit via the "main/standby" switch. The line compressor unit consists of a pre-amplifier to overcome the insertion loss of the mixing pad and a twin stage cascade compressor and line amplifier—the latter feeding four 600 ohm lines. This arrangement gives automatic compression of up to 30 db with a total distortion of better than 3 per cent.

A power amplifier is bridged across one of the 600 ohm lines and is capable of delivering up to 12 W of audio power to 12 headphone positions via a distribution board. The 12 headphone cables terminate in an attenuator unit fitted with a rotary switch giving four positions of attenuation. The microphone amplifier and line compressor units are fed from a double power supply unit situated in the left hand cubicle. The power supply, line compressor and headphone amplifiers are duplicated and change-over is effected by a multi-pin connector in the case of the power supply unit and a "main/standby" switch for all speech lines.

An intercommunication and call system is included for direct contact between the console operator and the recording studio.

Cooling Tower Design

IN the discussion on the I.E.E. papers on cooling towers which were reported in our last issue (page 15) Mr. F. H. S. Brown (B.E.A.), said that the paper by Messrs. G. F. Kennedy and P. H. Margen established the logic of a trend towards smaller cooling towers and associated higher circulating-water temperatures and therefore back pressures, and with this he agreed, but he was not so happy about the arithmetical values given by the authors. He did not agree that the charts, though an advance on anything he had seen of a similar nature, permitted the choice of economic cooling-tower data with an accuracy sufficient for practical purposes ; it would still be necessary to perform laborious calculations in any particular instance.

Mr. H. Chilton (Cooling Towers, Ltd.), dealing with the second paper (by Mr. Margen), said that with a family of similar surfaces a good correlation might be expected between the friction and the heat transfer, but with radically different designs of film packing there was a sporting chance of achieving improvement in transfer without corresponding sacrifice in friction. If the author's design method was adopted it would be necessary to redesign the packing for almost every new tower, and this might not be economically justifiable. He felt that the paper was a little before its time, in the sense that there were not at present the experimental data necessary to take full advantage of the friction/heat-transfer correlation ; but this should not deflect attention from the other valuable aspects of the work which could be applied at once with complete confidence.

Mr. B. Wood (Merz & McLellan) welcomed the authors' emphasis on the importance of exhaust loss and suggested that for small sets a high exhaust loading should be permitted. Coal might cost slightly more at small stations, but the exhaust would be used a great deal less, and more at part load. The big set would be used for more hours per annum and for a greater proportion of its time at heavy load, when the exhaust loss was significant.

Mr. G. J. Williamson (I.C.I.) gave additional data which went to show that film flow grid packings were better than film flow ring packings. Chemical engineers would like to use grid packings, and a recent development had been the use of glass and ceramic material in the form of grid packings.

Application in Tropical Conditions

Mr. B. Donkin (Kennedy & Donkin), dealing with the application of cooling towers in tropical conditions, said that, as the temperature of the climate increased, the closer the water temperatures approached the atmospheric wet-bulb temperature and the more favourable was the case for cooling towers as opposed to river cooling. A recent investigation had shown that in Rangoon the average wet-bulb temperature was about 7 deg F lower than the average river-water temperature. This made it possible to use a cooling tower which would give the station a thermodynamic efficiency no lower than it had at the moment with river-water cooling while avoiding the defects of the latter method.

Mr. H. J. Lowe (B.E.A.) supported Mr. Chilton's view that it was essential to establish the friction/heat-transfer characteristic for any type of packing before using the theory given in the second paper. Even then, caution would be necessary when dealing with large natural-draught towers, existing theories being based on simple counterflow conditions, whereas in fact there was a very complex combination of cross-flow and counterflow throughout the transfer region.

Mr. P. Betts (Merz & McLellan) agreed that on the whole large exhausts would pay in British conditions, but said that the proof was laborious. Those who were concerned with power stations abroad had often to say at short notice whether there should be a large or small exhaust, and ability to give the answer quickly would be useful.

B.E.A. Investigations

Mr. D. Clark (B.E.A.), expressing agreement with what the authors said about the over-liberal design of many cooling-tower installations in the past, said that for some time now the B.E.A. had been redressing this situation, even in stations already in construction or completed.

A good deal of work on rivers was going on and the B.E.A. had in hand investigations into the heating effect of their stations on rivers. The River Boards were not inactive either, but this was a long-term problem and reliable techniques had first to be established. The Hobday Committee had made it clear that there could not be general standards of universal application, and in view of the complexity of the subject it was not surprising that in the three years since the passing of the Rivers (Prevention of Pollution) Act no River Board had yet framed general by-laws specifying temperature. Meanwhile each new discharge had to be the subject of a consent, and the B.E.A. was gradually finding out the kind of temperature conditions which were going to be acceptable in specific cases.

Mr. C. G. Phillips, who was concerned with power generation projects approaching the magnitude associated with power stations, said it was relatively simple to show that the overall cost could be materially reduced by increasing the temperature range without impairing any factors concerned with compressor efficiency. The same kind of hangover from previous practice which was found in regard to temperatures might account for the apparently automatic invocation of water as the cooling medium in cases where it would seem that air could do the job just as well and for no extra cost, or, if extra cost was involved, with advantages to offset against it. An air-cooled condenser, however, was one of the items which at the moment he would be least inclined to propose, but if something quite unorthodox was contemplated the proposition was not impossible. The doubt which troubled him at the moment was whether any advantage would accrue.

Mr. P. H. Margen, replying to the discussion, agreed with Mr. Chilton that it would not save very much to design each packing for a particular case, but said that what he had in mind was that each maker would have, say, three packings, one for medium friction, one for very high friction and one for low friction, to cover the entire range.

He agreed with Mr. Betts that for hot climates the question of exhausts required even more investigation than for this country. The greatest difficulty which they had found in distinguishing between different exhaust ratings was that quotations from makers were based on B.E.A.M.A. cost rules and there was no guarantee that they reflected the actual changes in costs to makers. The problem was a serious one and should be investigated.

Hydro-Electric and Thermal Systems

Planning Problems Discussed

AT a joint meeting of the Institutions of Electrical and Civil Engineers last week a paper surveying world development in thermal and hydro-electric systems was presented by Messrs. T. G. N. Haldane and P. L. Blackstone (see *Electrical Review*, 7th January, page 8).

In the discussion Mr. T. Lawrie (North of Scotland Hydro-Electric Board) said that perhaps the most dramatic advantage of the development of hydro-electric power in the North of Scotland was that it was already saving 700,000 tons of coal per annum, a saving which would be doubled within the present decade as hydro schemes now building came into production. Peak-load water power had been developed to a large extent in Scotland, with a total figure of about 250 MW at an average load factor of 12½ per cent. This enabled steam plant in Central Scotland to operate with greater thermal efficiency at a steady load throughout the working day.

Load Factor Considerations

Mr. R. W. Mountain (Kennedy & Donkin) suggested that one of the values of peak load or very low load factor plant was its use essentially as stand-by plant. It might be more economical to provide stand-by plant in this way than by calling on the older thermal plant in other parts of the country.

Mr. F. J. Lane (B.E.A.), commenting on the authors' statement that it was difficult to restrict a peak-load thermal station to an annual load factor of less than 15 per cent, said that at present the B.E.A. had stations operating at annual load factors of 5 per cent or less, and by 1965 there would be stations operating at even lower factors. While it might be ideal that the load factor with nuclear energy generation should be kept high, conditions would probably in time lead to a reduction. Assuming a load factor of 75 per cent on atomic energy plant in 1965, by 1985, with the great increase in such plant, probably 30,000 MW of plant would be operating at 66·5 per cent, with some 50,000 MW of thermal plant operating at 20 per cent.

Mr. J. K. Hunter (Sir Alexander Gibb & Partners) said that in 1947-48 S.E. Canada suffered an abnormal shortage of precipitation which reduced by 45 per cent the output of energy from the Ontario Commission's stations on variable-flow rivers, and the Commission decided to provide thermal backing for their hitherto exclusively hydro system. Two major thermal stations were constructed, giving an additional 664 MW, and this saved the situation in the unfavourable conditions of 1953.

Mr. A. A. Fulton (North of Scotland Board) said that the authors had compared the incremental cost of increasing the installed capacity of a hydro plant with the cost of increasing the capacity of a thermal station, but another way of deciding whether to spend money on increasing the size of a hydro station was to see whether the rate of increase in annual charges was less than the rate at which the all-in unit tariff price increased with decreasing load factor. At current costs it seemed advantageous to increase plant capacity to the maximum, because the cost curve rose less steeply than the tariff curve.

Mr. E. M. Johnson (Metropolitan-Vickers) did not agree that the problem of increased output was principally one of transport and erection, or that the taking of machines to the site in pieces meant that certain tests which it was practicable to carry out only at the maker's works could not be made. It was possible, he said, to build a generator of almost any size which could be transported within almost any conceivable transport limits, and many machines erected on site had first been erected and tested in the manufacturer's works. To test one machine in four in this way cost well under one per cent.

Mr. C. W. Marshall (B.E.A.) said that in South Scotland out of a total of 1,250 MW they obtained 220 MW from the North of Scotland Board and 117 MW from the Clyde and Galloway, which accounted for 30 per cent of total peak requirements and would enable night power requirements to be met from hydro alone, though for security reasons in the industrial areas they operated a few of the most economic steam sets.

Mr. H. Headland, commenting on the authors' use of firm load factor based on the driest year, suggested for overseas projects an alternative economic assessment based on reliability, perhaps in terms of probability, since in under-developed countries the reliability need not approach the high values demanded in industrialized countries. It might be worth considering, even for this country, an economic assessment which gave different values for energy developed at different seasons of the year.

Dr. J. H. Walker (B.T.H.) said there were certain features in the design of a hydro station in which a reduction in cost could be obtained if the manufacturers received co-operation from consultants or customers. For example, the temperature rise of large water-wheel alternators should be related to the annual load factor of their station. With a steam set having a load factor of 80 per cent the life of the winding might be 30 years, but with a low load factor it would be 50-60. It would be better to increase the temperature rise by 10-15 deg and be prepared for the winding to burn out in 20 years.

Mr. D. J. Bolton (B.E.A.) thought it might be said that the cost of impounding in a storage hydro scheme, so far as it was a kilowatt-hour cost, was usually more than the fuel and other running costs of a steam station, but the kilowatt cost of a hydro scheme, or the incremental cost of increasing the pumped capacity, was in general less than with a thermal station. Therefore, the lower the design load factor the more economic the scheme was likely to be.

Mr. V. G. Newman (B.E.A.) said that the principles set out by the authors for the integration of hydro-electric with thermal generating plant were broadly in line with those followed by the B.E.A. In the course of time the load factor of coal-fired generating plant tended to decrease, as more efficient plant was brought into service, but for hydro plants the characteristics of the sites in the Authority's area were such that development could most profitably be carried out for peak-load generation at annual load factors of 10-20 per cent. In a pumped storage scheme which was planned the total capacity would be 300 MW and operation was intended to be on a five-day pumping cycle with generation over four hours a day, the daily load factor being about 16·7 per cent and the annual load factor 11·4 per cent. A hydro-electric scheme in Cardiganshire was also projected which would have a total capacity of 49 MW, an annual load factor estimated at 19 per cent and a storage capacity corresponding to 21 per cent of the average annual output.

BUSBARS for Electro-Chemical Applications

Constructional Features and Methods of Installation

By K. M. G. STEWART, A.M.I.E.E.*

THE term busbar, which has been contracted by common usage from omnibusbar, is usually applied to a main electrical conductor in a distribution system, so arranged that it receives current from one or more sources of supply and delivers it to one or more outgoing sub-circuits.

This article is concerned with the type of busbar which is associated with electroplating and allied electro-chemical plants, and which has, as a result, several features which distinguish it from the many other possible forms of busbar installation. The features which together make this type of installation unique are that the busbars are usually indoors and unprotected and carry heavy low-voltage direct currents.

TABLE I.—VARIATIONS IN ECONOMICAL CURRENT CARRYING CAPACITY WITH DIMENSIONS

Conductor dimensions	Current carrying capacity (amperes)	Surface area per inch of length (sq in)
1½in dia. rod	950	3·92
1in by 1in	1,100	4·0
2in by ¼in	1,120	5·0
4in by ¼in	1,380	8·5
8in by ¼in	1,900	16·25

A busbar installation must be considered as an essential part of a plant, and should therefore be approached as a problem in design, as must any other piece of electrical machinery. It is not sufficient to choose a bar on the basis of some purely arbitrary figure for current density, as good design demands that certain other factors must be considered. Electrical adequacy is important, but so are temperature rise, voltage drop, mechanical adequacy, choice of material, conductor shape, jointing methods, proximity effect, protection, and power economy.

There are two extreme possibilities in the initial design of a busbar run. Firstly, a very highly efficient run could be installed, but a large quantity of material would be required and the capital cost would be correspondingly high. The cost of the power wasted would be small, but the interest on the invested capital would be heavy, and so the cost of the power delivered would also be high. On the other hand, a run of small cross-sectional area, and therefore small capital cost could be installed, but the power losses would be great with the result that the cost of the power delivered would again be high.

Between these two extremes will be found a compromise, which, together with other factors that will be considered, will enable the minimum cost to be incurred for any given installation. This compromise is the basis of Kelvin's Law which is just as applicable to busbar runs, as it is to other forms of transmission line.

For practical purposes, it may be assumed that there are only two metals that are used as a busbar material, namely hard drawn, high conductivity copper, and aluminium of 99·5 per cent purity, and we shall first discuss some design considerations of an installation of copper bar.

Current Density

For many years it has been common practice to assume a current density of 1,000 A/sq in of cross section for copper, when choosing a conductor to carry a given current, but this method is both unscientific and uneconomical. This figure appears quite ridiculous when it is realized that the current density in a 34 s.w.g. copper wire carrying 5 A exceeds 80,000 A/sq in, while that in a 4in diameter bar carrying 5,300 A is only just over 300 A/sq in.

Table I of carrying capacities for equal area conductors shows that the economical current density varies with the conductor size and shape because of the resulting variation in radiating surface. Detailed investigations into the current carrying capacity of copper for busbars have been undertaken by various authorities at different times, and their published results are in very close agreement. Table II is based on these figures, and may be taken as being the most economical for the given bar sizes.

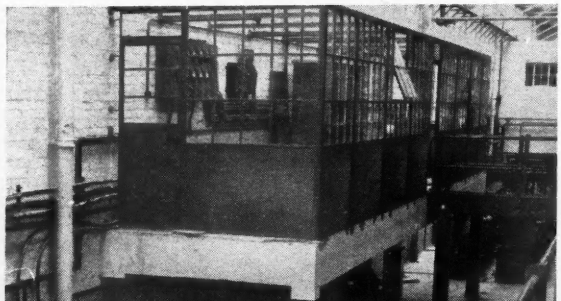
Working Temperature

As we are concerned with handling heavy current l.v. d.c., it is important to keep the voltage drop as low as possible, and this can obviously only be done by keeping the total resistance of the run to the minimum. In practice this means good jointing and low working temperatures.

TABLE II.—PRACTICAL VALUES FOR CURRENT CARRYING CAPACITY OF SINGLE BUSBARS AND RELATIVE DATA UNDER CONDITIONS NORMALLY FOUND IN THE PLATING SHOP

Section	C.S.A. in²	Radiating Surface per foot (in²)	Copper		Aluminium		Max. Temp. (from 30° C ambient)
			max I	V.D. per 100ft at max I	max I	V.D. per 100ft at max I	
1″×¼″	¼	27	250	1·65	200	2·54	60° C
1″×½″	½	30	400	1·35	300	1·92	65° C
2″×¼″	½	51	500	1·70	400	2·56	66° C
2″×½″	1	54	750	1·30	550	1·76	69° C
4″×¼″	1	99	950	1·65	800	2·56	68° C
3″×½″	1½	78	1000	1·16	850	2·00	64° C
2″×½″	1	60	1100	0·94	850	1·36	68° C
4″×½″	1	102	1350	1·15	1100	1·75	68° C
3″×¾″	1½	81	1350	1·05	1000	1·40	70° C
5″×½″	1½	126	1650	1·05	1350	1·75	68° C
3″×½″	1½	84	1550	0·85	1100	1·21	68° C
4″×¾″	1½	81	1700	1·00	1350	1·49	70° C
6″×½″	1½	150	1950	1·05	1600	1·76	70° C
5″×¾″	1⅞	129	2050	0·90	1650	1·48	70° C
4″×½″	2	108	2000	0·90	1550	1·24	70° C
6″×¾″	2¼	153	2400	0·90	1950	1·37	68° C
5″×½″	2½	132	2400	0·80	1900	1·14	70° C
6″×½″	3	156	2800	0·80	2200	1·10	70° C

* Electro-Chemical Engineering Co., Ltd.



Lapped joints at the termination of busbar runs; the bars are not fixed, but merely rest on their supports, so that they may move under thermal expansion

According to clause 10 of B.S. 159 : 1932, for unprotected bare conductors in direct contact with air and rated at 2,000 A and below, the temperature rise should not exceed 40 deg C above an ambient of 30 deg C, while that for bars rated at above 2,000 A should not exceed 50 deg C above an ambient of 30 deg C. If the ambient temperatures are higher than 30 deg C, then the current rating should be reduced so that the maximum temperatures do not exceed 70 deg C or 80 deg C. These limits of temperature have been fixed by the fact that above 80 deg C the rate of oxidation of copper increases rapidly in air and excessive local heating may occur at joints.

Types of Joint

A joint in a busbar is efficient only if it is mechanically strong and has a permanently low resistance. A number of alternative methods may be employed to achieve such a joint, such as welding, soldering and riveting, but the

Lapped and butt joints at the termination of busbar runs

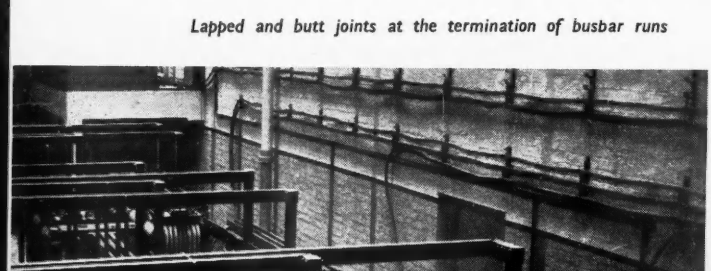


Fig. 1.—(A) An untidy and awkward method of producing a "straight" run with lapped joints. (B) This method requires staggered insulators. (C, D) These methods produce a straight run but have the disadvantage that an average of one double set per length of bar is required. This type of installation is time consuming and requires two men to make the necessary bends. (E) A true straight run requiring the use of fishplates

methods usually employed in practice are bolting or clamping, as these have the advantage of simplicity and cheapness.

Clamped joints have the advantage that the effective section of the bars at the joint is not reduced by drilling for bolts, the contact pressure is fairly uniformly distributed over the contact area, the bars may be disassembled quickly if necessary, and the large bulk of metal at the joints assists in cooling.

Compared with clamped joints, bolted joints are more compact, a higher joint pressure is possible local to the bolts, joints between bars of different dimensions or shapes are more easily made, and the larger the installation the less the relative cost per joint.

The electrical resistance of the joint arises from two factors: the contact resistance at the conductor interfaces, and the streamline effect, the latter term being applied to the distortion of the lines of current flow between two conductors in an overlapping joint. It has been demonstrated that the density of current flowing across the contact surfaces is higher at the extreme ends of the overlapping bars than it is at the centre of the joint, and the effect of this phenomenon upon the joint resistance is dependent upon the ratio of the length of overlap to the bar thickness, but not upon the width if both bars are equal.

If the length of the overlap is increased from three to ten times the bar thickness, only a 20 per cent reduction in resistance will result, while the effect of increasing the length of overlap still further will be negligible. It is, therefore, evident that, other considerations apart, there is no advantage in employing an unduly long overlap. In practice the length of overlap should be equal to the width of the widest bar in the joint, or ten times the mean thickness of the bars, whichever is the greater.

Whenever possible the joint should be interleaved, so that air spacing is maintained between the bars in the run, and in most cases a simple lap joint is sufficient. In a straight run, however, this type of joint has the disadvantage that each successive section of the run is displaced to the right or left by an amount equal to the thickness of one bar. Consequently, the run will not progress in a straight line, but in a series of steps, and the insulators and supports will have to be arranged accordingly (see Fig. 1). Where it is necessary for appearance or other reasons to have a run in a straight line, the bars may be butted together at the ends, and fishplates used to make the joint (see Fig. 2). There will be little difference in the electrical efficiency of this type of joint compared to the simple lap joint, but there is a disadvantage in the fact that twice the number of bolts

will be required, and the cost of preparation and erection will be correspondingly higher. The short pieces of bar required for the fishplates can usually be made from off-cuts, and other short lengths, normally recovered as scrap.

The contact resistance of a joint is itself dependent upon two factors, which are the contact pressure and the condition of the interfaces. The contact surface of the bars must be flat, smooth, and clean. Machining of the surfaces is not normally necessary, but draw filing is advisable to remove any obvious high points, due for example to the bar having been dropped on one corner, or where bolt holes have been drilled or punched. After flattening where necessary, the contact surfaces should be thoroughly cleaned with a medium grade carborundum cloth to remove the oxides and other surface contaminants that may be present. As soon as possible after cleaning, the surface should be smeared with clean industrial grade petroleum jelly, preferably by means of a piece of rag reserved for this purpose only. The preparation of contact surfaces by methods such as tinning, nickel plating, or covering with a sheet of tin foil have no advantage in normal circumstances, and even under severe conditions such as high temperatures or contaminated atmospheres, the advantage of such preparations over the normal method described above, are questionable.

Contact Pressure

The greater the applied pressure to a joint, the lower will be the contact resistance, and it is therefore important to ensure that a high contact pressure is achieved when making a joint. It should be appreciated that the area of greatest pressure in a bolted joint is that which lies beneath the head of the bolt, and for this reason it is advisable to employ large plain washers under the bolt head and under the nut. Practical values for adequate contact pressures lie between 250 and 2,500 lb/sq in. It would be inadvisable to employ a pressure below 250 lb/sq in as its crushing action would not be sufficient to ensure intimate contact between the two surfaces, while higher pressures than 2,500 lb/sq in may stress the bar beyond its elastic limit in the area immediately beneath the bolt head. In practice, these desired pressures are usually obtained by the average workman, using a spanner of normal dimensions, if he tightens the nuts as far as he is able.

Supports

The functions of a support are to carry the weight of the bars, to maintain them in a fixed position, to insulate them from adjacent conductors, and to allow the bars to move under the influence of thermal expansion.

As the busbars in the plating shop are rarely at a potential higher than 20 V, it is unnecessary to employ insulators having high voltage ratings. Practically any of the cheaper paper-based laminates are suitable for constructing supports as they will be electrically adequate and have high compressive strengths.

Thermal Expansion

The coefficient of linear expansion of copper is usually given as $16{\cdot}6 \times 10^{-6}$ per deg C or $9{\cdot}2 \times 10^{-6}$ per deg F. This means that busbars expand 0·008in for every foot of their length for a rise in temperature of 40 deg C from 0 deg C. This expansion is nearly an inch for every 100ft. It is therefore necessary to ensure that the bars are allowed to move longitudinally, particularly on long straight runs, as otherwise damage may be caused to the terminals, particularly if they are fixed to immovable objects such as grouted-in plants. Also, if the bars are not allowed to expand in a straight line, they will form a curve, which will decrease the clearance between the bars and any adjacent conductors, such as steelwork, and also impose undue stresses on intermediate supports.

It is rarely necessary to introduce expansion joints into plating shop runs, as there are usually fairly frequent changes of direction in the run, which provide adequate opportunity for any change in length to take place. Should it be necessary to have a long straight run of bar, with no provision for expansion at the ends (such as a bend) it is advisable to introduce an expansion joint. This is simply a short section of the run that is constructed of a large number of small conductors, such as strips, strandings, or braid. The current carrying capacity must of course be that of the main run, to which they are bolted. The strips, etc., of which the joint is made are usually formed

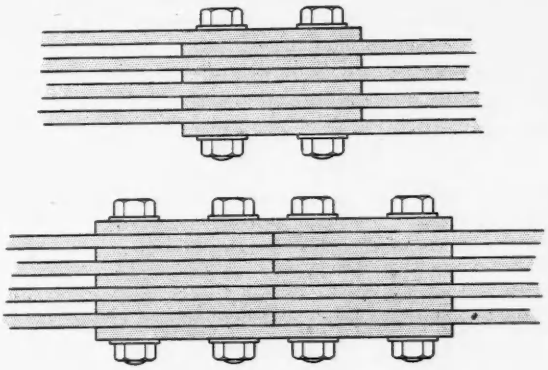
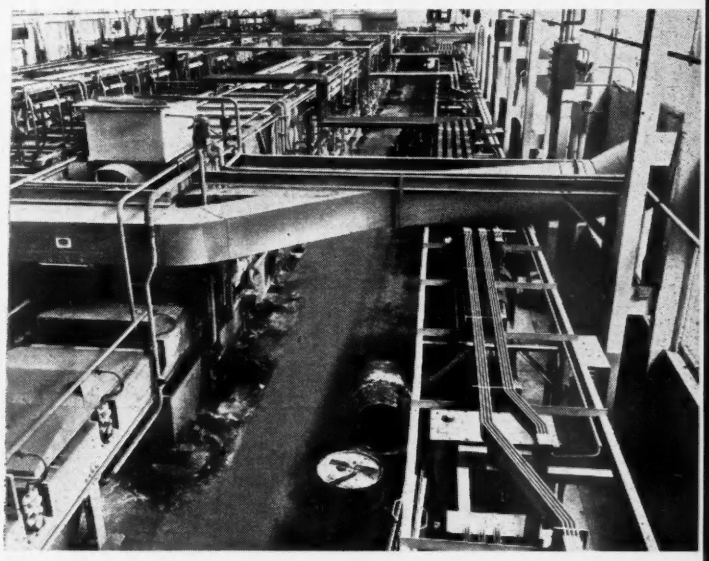


Fig. 2.—Top: A simple lapped joint in a run of four ¼in bars. Note how each section of the run is displaced from the other by the thickness of one bar. Bottom: A butt joint in the same run. Twice the number of bolts to a lapped joint are required, but erection is simplified by straight runs, and appearance is improved

Long straight runs of busbar resting in "combs" under their own weight. With this method of support, and with bends at each end of the run, no expansion joints are necessary



into a " Z " or a shape like the capital omega. It should be noted that if the end of the braid is tinned to facilitate drilling the bolt holes for fixing it to the main run the tinned portion should be kept as far as possible from the point of flexure. Otherwise, quite severe bending may take place at the junction of the rigid and flexible portions of the braid, which in the course of time may result in their fracturing.

Aluminium Conductors

Now that a few of the points concerning copper busbars have been mentioned, the alternative choice of aluminium as a conductor material, will be considered.

According to B.S. 159 : 1932, the value of maximum resistivity specified for aluminium as a conductor material is 2·87 $\mu\Omega/cm^3$ at 20 deg C, and this corresponds to 60 per cent conductivity of the annealed copper standard. Manufacturers of aluminium busbars use a specially pure grade of the metal, the electrical resistivity of which is on an average slightly less than the maximum figure quoted above, and for purposes of calculation, the relative conductivity of aluminium to copper may be taken to be 60·6 per cent.

As many of the remarks which have already been made for copper bars are equally applicable to aluminium bars, it will only be necessary to discuss those features which particularly apply to aluminium, because of the special nature of the metal.

Aluminium is softer and lighter than copper and when in contact with the air, a film of oxide of high electrical resistance forms on the surface. These characteristics deserve special attention when aluminium is considered as a busbar material.

The fact that it is soft, means that it is more liable to be damaged during erection, and it should therefore be handled more carefully. The advantages lie in the fact that bending, drilling, cutting, etc., are easier, and its low weight adds to the ease and speed of erection.

Current Carrying Capacity

Because of the lower figure for conductivity, aluminium bars to carry a given current will be slightly larger than their copper equivalents. As they have a larger section, they will also have a larger radiating surface and therefore the temperature rise will be lower. To ensure the greatest economy in an installation it is necessary to reduce the size of bar as much as possible paying due attention to voltage drop, etc., and from the above it will be seen that in practice, the ratio of cross sectional areas of aluminium and copper will not be the same as the simple ratio of their relative conductivities, but will be slightly less in favour of the aluminium. As an example, for a 40 deg C temperature rise, a 3in by $\frac{1}{4}$in copper bar may be loaded to a little over 1,000 A, while under the same conditions, for the same temperature rise, a 3in by $\frac{1}{4}$in aluminium bar can carry about 860 A and not just over 600 A, as might be expected.

As most readers will probably be more familiar with estimates for copper bar, those who wish to estimate for aluminium may do so quite easily by remembering that in practice, the equivalent of a given rectangular copper bar in aluminium is either 25 per cent wider or 50 per cent thicker. To obtain the most economical use of metal, it is preferable whenever possible to increase the width rather than the thickness.

TABLE III.—FACTORS GIVING CAPACITIES OF MULTIPLE-BAR RUNS

No. of parallel bars	Aluminium	Copper (up to 4in wide)	Copper (4in to 8in wide)
2	1·85	1·84	1·60
3	2·55	2·52	2·20
4	3·30	3·20	2·80
5	4·00	3·88	3·40
6	4·80	4·56	4·00

Jointing Methods

It is important when making joints to ensure that the joint surface is clean and free from the oxide skin. It is not sufficient to employ the same procedure as that used when jointing copper, because the oxide film on the surface will re-form as soon as it is removed. It is essential that once the oxide film has been removed, the surface of the bar is not allowed to come into contact with the air.

This can be achieved by smearing the surface of the bar with petroleum jelly before cleaning. Without removing the jelly, clean the bar in the normal way, using a scratch brush, steel wool or coarse carborundum cloth. When the surface has been cleaned in this manner, remove the swarf and surplus petroleum jelly by wiping off with a cloth. A thin film of jelly will remain on the surface, which should be augmented by the application of more clean jelly. Because the oxide film has been removed under the petroleum jelly, a fresh film will not be formed immediately, and the remaining film of jelly will ensure that the surface of the bar remains clean. When the joint is assembled and bolted up, the surplus jelly will be squeezed out of the joint, when it may be removed, but it will also fill all the interface crevices, and should ensure that the joint remains in good condition indefinitely, as it will prevent the ingress of air and moisture. The process of cleaning the bar ends as described above should be the last operation before the joint is made, all holes, etc., having been drilled beforehand.

It is almost inevitable that in an installation of aluminium busbar, a joint between dissimilar metals will have to be made. This will occur at the terminals of the machine, rectifier, etc., to which the bars are connected, where an aluminium to copper joint will be necessary, at a shunt where the end blocks are of copper or brass, or in a normal joint where the bolts are not of aluminium alloy. It is important to remember that electrolytic action between these dissimilar metals will not take place without the presence of moisture, and the ingress of moisture will be avoided if the procedure described above is carefully carried out.

It is advisable when using steel bolts to have them plated with cadmium, zinc or nickel to further reduce the possibility of electrolytic action and these bolts may be used universally when bolting aluminium to any other metal normally found in a busbar installation. A further precaution to prevent the entry of moisture is to paint over the joint, although this is not really necessary if the bars are in a dry atmosphere.

Multiple Runs

Normal practice is to run rectangular bars so that in a horizontal run they stand vertically on edge. When two or more conductors are parallel, it is usual to space them at a distance equal to their thickness to allow air to circulate over the surfaces of all the bars. Because of the mutual shielding of the inner faces of the bars in a multiple run, the current carrying capacity of " n " bars is not " n " times the capacity of a single bar. Further, it is not usually economical to run more than six bars in parallel. Table III sets out multiplying factors which will give the capacity of any multiple bar run, if the current carrying capacity of one bar is known.

Acknowledgment is due to the Electro-Chemical Engineering Co., Ltd., for permission to publish this article and for the loan of the photographs.

Power Supply Network

By J. V. PARRY, M.Eng.*

THE calculation of current distribution in both a.c. and d.c. power supply systems has been shown to be facilitated by the application of a theorem first stated by Helmholz in 1853 and later by Thévenin in 1883.[1, 2] The theorem is now usually referred to as " Thévenin's Theorem " and may be stated as follows[3]:—With respect to any single external circuit connected to any pair of terminals of a network, the network can be replaced by a single branch having an impedance, Z, equal to the impedance measured at these terminals looking into the network, when all the network e.m.f.s are short-circuited, and containing a single e.m.f. Eo equal to the open circuit voltage of the network across the given terminals.

The application of this theorem to the solution of ordinary network problems is very useful and well known. When, however, it is applied to the solution of distribution problems in power supply systems it has been found that care must be exercised in its application since the solution obtained may be either the exact solution, or an approximate solution depending on the type of problem which is being considered. The difference between the two types of problems, and the solutions obtained, is made clear by considering the following two problems. The solution to the first problem is usually obtained by the exact application of Thévenin's theorem but the solution obtained is only approximate; while the second problem is solved using a modification of Thévenin's theorem and an exact solution is obtained.

The first problem to be considered is shown in Fig. 1, where r_1 and r_2 represent the total resistance of the conductors, both go and return, feeding loads at a and b. The loads have resistances R_1 and R_2 and carry currents I_1 and I_2 respectively. The generator has an e.m.f. E and negligible resistance. It is required to determine the current that would flow in an interconnector, with total resistance r_c, if it were joined between a and b.

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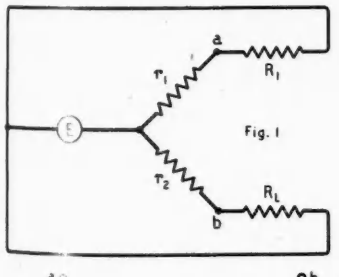


Fig. 1

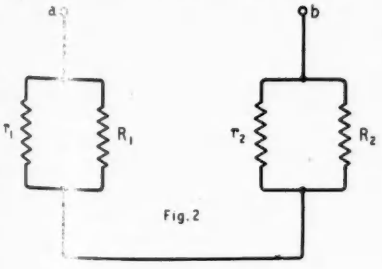


Fig. 2

Calculation of Current Distribution

The method usually adopted is to determine the voltage Eo between the points a and b with the currents I_1 and I_2 flowing; this is the open-circuit voltage mentioned in Thévenin's theorem; the resistance looking into the network is taken as $r_1 + r_2$; the current flowing in the interconnector is then given as:—

$$I_c' = \frac{Eo}{(r_1 + r_2) + r_c}$$

This is, however, an approximate solution since the resistance of the loads has been ignored in calculating the resistance " looking into " the network. If these load resistances are taken into account we have the network shown in Fig. 2 for calculating the resistance looking in at a and b, which is therefore,

$$\frac{r_1R_1}{r_1 + R_1} + \frac{r_2R_2}{r_2 + R_2}$$

The actual current, therefore, that would flow in the interconnector when connected is

$$I_c = \frac{Eo}{\frac{r_1R_1}{r_1 + R_1} + \frac{r_2R_2}{r_2 + R_2} + r_c}$$

If $R_1 \gg r_1$, and $R_2 \gg r_2$ as is usually the case, the value of I_c is very nearly equal to I_c'; hence the value obtained for I_c' is usually a sufficiently accurate solution to the problem.

The second type of problem is shown in Fig. 3. The network supplies loads I_1, I_2, I_3 at the points b, c, d and it is fed at a; the resistances of the feeders are r_1, r_2, r_3, r_4 as shown, and the points b and d are joined by an interconnector of resistance r_c. The current flowing in the interconnector is to be determined.

The method of solution often suggested is not an application of Thévenin's theorem as stated above, but of a modified theorem which may be stated as follows:—To determine the current in one branch of a network which supplies given currents at various load points, consider the branch to be broken at one point *and also the currents flowing in the loads to remain unaltered.* The current flowing in the branch is then the ratio of the calculated voltage across the break to the impedance of the network viewed from the break, all e.m.f.s being short-circuited and all branches which *have the given currents flowing in them open-circuited.*

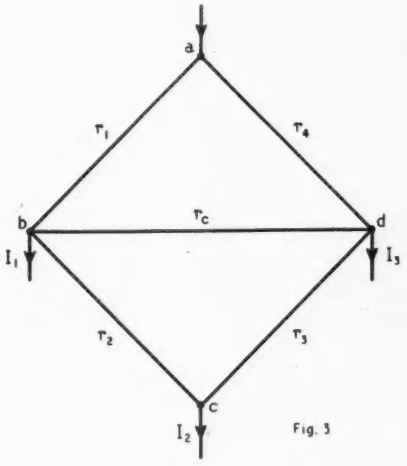


Fig. 3

This modification will be shown to be only a quick method of writing down the exact solution to the problem, as obtained by the direct application of Kirchhoff's laws. It will be observed that unless the loads considered are constant current ones, that is, the currents flowing are independent of the voltage across them, the method of solution does not involve the

voltage that would appear across the break in an actual circuit, but the voltage that would appear if the loads were constant current ones.

To solve the problem of Fig. 3, using the modification of Thévenin's theorem, assume that a break is made in the interconnector bd and all load currents remain unaltered. Let a current I_a^1 flow into the network now obtained as in Fig. 4, and applying Kirchhoff law to the mesh abcd we have

$$I_a^1 r_1 + (I_a^1 - I_1) r_2 + [I_a^1 - (I_1 + I_2)] r_3 + [I_a^1 - (I_1 + I_2 + I_3)] r_4 = 0$$

$$\therefore I_a^1 = \frac{I_1 r_2 + (I_1 + I_2) r_3 + (I_1 + I_2 + I_3) r_4}{r_1 + r_2 + r_3 + r_4}$$

Fig. 4

The voltage across the break in branch bd is derived from the expression

$$v = -(I_a^1 - (I_1 + I_2 + I_3)) r_4 - I_a^1 r_1$$

The resistance of the network "as viewed from" the break is determined from Fig. 4, which is obtained from Fig. 3 by short-circuiting the e.m.f.s and open-circuiting the load branches. Since there are two branches in parallel and r_c is in series with them, the resistance is given by

$$r = r_c + \frac{(r_1 + r_4)(r_2 + r_3)}{r_1 + r_4 + r_2 + r_3}$$

The current in the interconnector is given according to the modified theorem by

$$I_c = \frac{v}{r} = \frac{(I_1 + I_2 + I_3) r_4 - I_a^1 (r_4 + r_1)}{r_c + \frac{(r_1 + r_4)(r_2 + r_3)}{r_1 + r_4 + r_2 + r_3}}$$

$$\therefore I_c = \frac{(I_1+I_2+I_3)r_4 - \frac{r_1+r_4}{\Sigma r}\left[I_1 r_2 + (I_1+I_2) r_3 + (I_1+I_2+I_3) r_4\right]}{r_c + \frac{(r_1+r_4)(r_2+r_3)}{\Sigma r}}$$

The result may be determined directly from Fig. 3 by assuming a current Ia flowing in the feeder ab, and I_c in the interconnector. Applying Kirchhoff's laws to the meshes abcd and abd respectively, we have

$$Iar_1 + [Ia - (I_c + I_1)] r_2 + [Ia - (I_c + I_1 + I_2)] r_3 + [Ia - (I_1 + I_2 + I_3)] r_4 = 0 \quad \ldots (1)$$

$$\text{and } Iar_1 + I_c r_c + [Ia - (I_1 + I_2 + I_3)] r_4 = 0 \quad \ldots (2)$$

$$\text{Equation (2) gives } Ia = \frac{(I_1 + I_2 + I_3) r_4 - I_c r_c}{r_1 + r_4} \quad \ldots (3)$$

Substituting equation (3) in equation (1), after rearranging we have

$$\Sigma r \left\{ \frac{(I_1 + I_2 + I_3) r_4 - I_c r_c}{r_1 + r_4} \right\} - [I_1 r_2 + (I_1 + I_2) r_3 + (I_1 + I_2 + I_3) r_4] = I_c (r_2 + r_3)$$

$$\therefore I_c = \frac{(I_1+I_2+I_3)r_4 - \frac{r_1+r_4}{\Sigma r}\left[I_1 r_2 + (I_1+I_2) r_3 + (I_1+I_2+I_3) r_4\right]}{r_c + \frac{(r_1+r_4)(r_2+r_3)}{\Sigma r}}$$

From a comparison of the two results, it is seen that the application of the modified form of the theorem gives the exact solution of the problem. It will also be seen, from a comparison of the forms in which the two solutions are obtained, that the modified Thévenin method gives a quick means of obtaining the solution which does not involve the solution of the two simultaneous equations.

References

[1] *Wireless Engineer*, Vol. 20, 1943. G. W. O. Howe: "The Make and Break Network Theorem of Helmholz."

[2] *Comptes Rendus*, Vol. 97, 1883. L. Thévenin: "Sur un Nouveau Theorem d'Electricite Dynamique."

[3] *The Electrical Journal*, Oct., 1938. E. L. Harder: "Thévenin's Theorem."

A Further Call for Science Teachers

AT the annual dinner of the Southern Centre of the Institution of Electrical Engineers recently, Mr. J. Eccles, president of the Institution, strongly upheld the plea for more recruits into the technological field. This was an age of technology, he said, and whether we liked it or not, we were faced with the prospect of an increasing application of science in the industrial economy of this country. The day was long past when the pious humanitarian could afford to lift up his eyes unto heaven and say, "I thank God that I am no dabbler in kilowatts." Science and engineering so permeated our workaday world that we neglected them at our peril. If we were to provide an acceptable existence for our fifty million people, we must have scientists and engineers who in quality and quantity were at least comparable with those of other industrial countries.

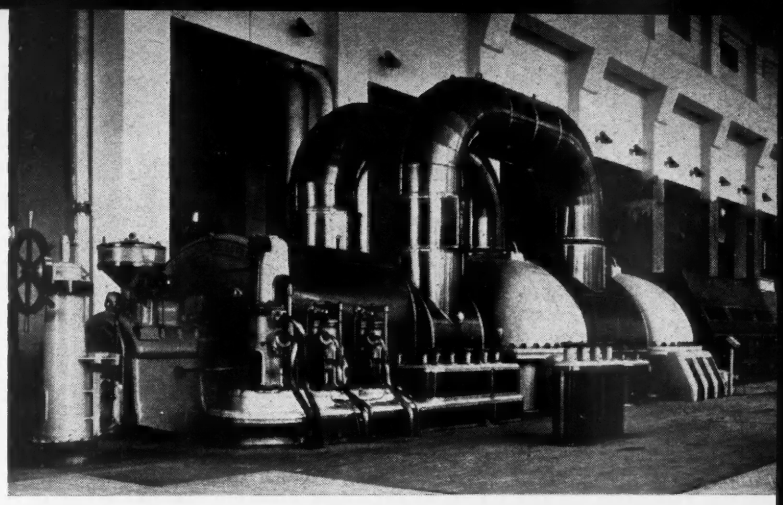
Technology must be taught in our schools, in our technical colleges and in our universities. The Government had recently made a welcome announcement on the increases in money grants for university education; but what was equally important was the teaching of science in schools where the future engineering student received his basic grounding. And what a hard job it was to teach science in these days when even before school age—certainly before school science age—the boys had learnt all about rockets, space ships and interplanetary travel.

The science master filled a difficult role, but the sad thing was that there was not enough of him. Posts were vacant and even good secondary schools were fortunate if they attracted one applicant as the result of an advertisement. The truth, of course, was that remuneration paid to science masters was very much less than that which the same man could attract in industry. That was a matter which demanded the serious consideration of our education authorities.

Scientific education began at school and there were too few science teachers; so it was imperative that more should be recruited and it seemed certain that this would not be done until their remuneration and prospects were substantially improved. Education authorities should act in this matter before it was too late.

ELECTRICAL PROGRESS—1954

Activities of the English Electric Co., Ltd.

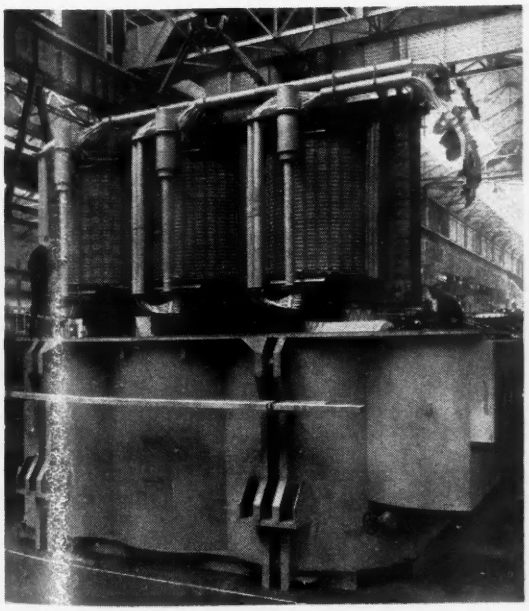


30 MW, 3,000 r.p.m. turbo-alternator in Salmisaari power station Helsinki

DURING 1954 the English Electric Co., Ltd., received many orders for steel works electrification plant among which were five hot reversing mill main drive equipments for blooming and slabbing purposes, the ratings varying from about 3,000 h.p. in the conventional single armature form, to 8,000 h.p. in the twin drive form. A non-ferrous plant in Canada will contain a complete set of English Electric equipment for various hot and cold rolling mills. Other cold strip mill equipments ordered during the year included machines and control gear for the modernization of an existing cold tandem mill doubling the strip speed of production. Equipment installed during 1954 included a 7,000 h.p. plate mill main drive complete with edger, three a.c. drives for roughing stands and Ward-Leonard auxiliary drives in Australia; W.-L. auxiliary drives for roller tables, etc., on a blooming mill in Norway; and a cutting-up line for heavy strip in Australia.

In the Transformer Department the 80 MVA 230 kV transformer of the first of the American post-war contracts for this type of equipment was dispatched and is now installed on site at Folsom. The Department's output of large transformers included two 30 MVA, two 45 MVA and two 60 MVA transmission units, three 72 MVA generator transformers (all at 132 kV) and the second 120 MVA 275/132 kV auto-transformer for the supergrid. Orders received from the British Electricity Authority included two 30 MVA, 132 kV transmission transformers, and two 72 MVA, 132 kV and two 64 MVA, 33 kV generator transformers. In the export market several large contracts were secured, an outstanding example being twelve 110 kV transformers totalling 309 MVA for Russia. Other orders included two 40 MVA, 80 kV and two 70 MVA, 132 kV transformers for South Africa and two 60 MVA, 230 kV units for Canada.

120 MVA, 275 kV auto-transformer for the B.E.A., during works erection



During the year considerable development work has taken place and two new circuit breakers, for ratings up to 750 MVA at 33 kV, have been fully proved. Various oil circuit breaker orders, both for home and overseas, for indoor service up to 33 kV and outdoor from 33 kV up to 132 kV, were received. These included the contract for the whole of the switchgear for the Kelvin power station of the City of Johannesburg. The main gear is 88 kV, 2,500 MVA, and the auxiliary is 3·3 kV and 400 V.

Among orders for air-blast gear was one from the B.E.A., for the 132 kV and 275 kV substations at Rochdale, the breakers having rupturing capacities of 3,500 MVA and 7,500 MVA, respectively.

In the steam turbine field the larger units ordered by the B.E.A. included the third 100 MW set for Willington "A" power station and the fourth 60 MW set for Wakefield. Export orders included a 60 MW set for Athens and a 45 MW set for Halifax, Nova Scotia. The first 60 MW set operating at 1,500 lb/sq in and 1,050 deg F to go into commission in this country was started up at Stourport and the first of four similar units was commissioned at Drakelow. Seven of the twelve 30 MW sets for the Vierfontein power station of the Electricity Supply Commission, South Africa, are now in operation.

In the Rectifier Substation Department orders for electro-chemical duty included a fourth equipment, rated at 12,000 A, 325 V, for the Nchanga Copper Refinery of the Anglo-American Corporation. Steel works absorbed a considerable number of rectifiers for auxiliary services. Other rectifier equipment orders were for shipyards, for collieries and for charging underground locomotive batteries. Rectifier equipments put into service during the year included two 4,800 A, 750 V units, for extending the capacity of an aluminium reduction plant in Norway.

Orders for both diesel and dual-fuel engines for home and abroad increased during the year. An interesting installation, commissioned in October last, is at the Lasham pumping station of the Mid-Wessex Water Company. This consists of an 8SRK pressure-charged diesel-engine-driven alternator set. At Zanzibar and Bathurst (Gambia) diesel-engine-driven alternator sets, using 7SRL engines, were commissioned. At Port Sudan and Atbara, 5SRL engines and alternators are in course of erection, while

repeat orders for further sets are in hand for Zanzibar and Port Sudan.

Contracts are in hand for electrical machines and for diesel engines for propulsion and auxiliary service in merchant vessels. Several orders for such machinery were completed during the year.

A prototype geared steam turbine of advanced design, developed to meet Admiralty requirements, has been delivered to Pametrada Research Station ; the exhaustive tests on this unit are scheduled to commence in the near future. Electrical propulsion equipments of a new design are being delivered for installation in the latest submarines of the Royal Navy. This machinery also was developed by the company in collaboration with the Admiralty.

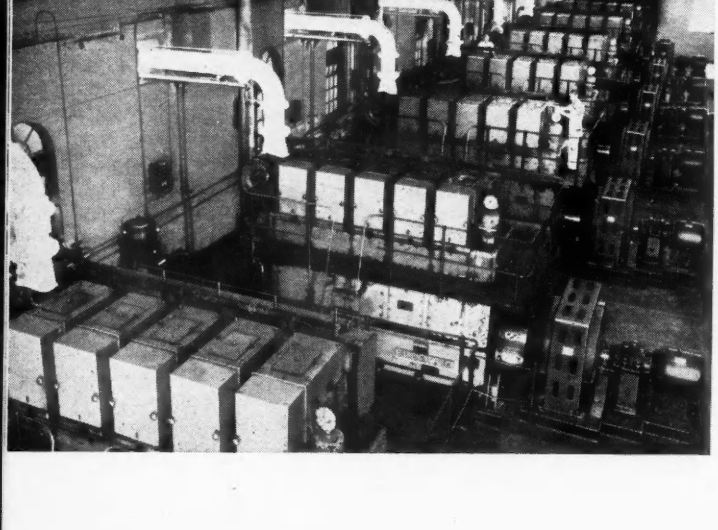
Orders for hydro-electric equipment received included contracts for Scotland, Australia, Rhodesia, Canada and Turkey. Plant was put into commission at Cabril in Portugal, Victoria Falls, Sengulam in India, Waitaki in New Zealand, Luichart in Scotland, Kemano in British Columbia, Salime in Spain, and at the Ghost River project in Canada.

Typical orders for diesel-electric locomotives included those for the Argentine Railways (1,000 h.p.) and for New Zealand Railways (750 h.p.). Additional 400 h.p. equipments for diesel-electric shunting locomotives for British Railways were put in hand. Deliveries included locomotives for New Zealand and Brazil (the mechanical parts for the latter locomotives were built by the Vulcan Foundry, Ltd.), the Gold Coast, Nigeria and the Netherlands.

Among orders for electric traction equipment were those from the Central Railway of India and British Railways. Electric locomotives were delivered during the year to Victoria, Spain and India. Further 980 h.p., 675 V d.c. motor coach equipments were supplied to the Southern Region of British Railways, where over 1,000 motor coaches are provided with English Electric equipment.

Orders were received from several firms of woollen and worsted manufacturers in Yorkshire, which involved conversions to electric drive and extensions to existing driving plant. Contracts were also secured for electrical conversion schemes at Indian jute mills, involving driving motors, control gear, h.v. and l.v. switchgear and substation equipment. From Pakistan came orders for individual jute machinery drives and distribution equipment.

Seven 580 kW diesel alternator sets in the Civic (Newcastle) power station of the Electricity Commission of New South Wales



In the cotton industry several overseas contracts were secured for complete electrical driving plant for both spinning and weaving mills, together with extensions of plant in existing factories. Continued business was obtained from cotton ginnery installations abroad for complete electric drives and diesel-alternator sets.

Home and overseas orders for mine winders and haulages, with associated control gear, were received during the year. Home orders included equipment for the National Coal Board. Both Ward-Leonard and a.c. winders were included among the business. The majority of the a.c. winders are to be equipped with d.c. dynamic braking. Eighteen winders were commissioned, among these being the first ground type, direct coupled, single rope, Koepe pulley winder to be installed in Great Britain.

Several large contracts, in which electronic control plays a vital part, were successfully concluded, while work commenced on new industrial projects. Those completed include controls for paper machines and schemes which incorporate automatic systems for improving production methods for a variety of industries, including steel and chemicals, to quote only two examples.

Standard controllers, with improved performance, having ratings from 0·5 h.p. to 100 h.p. continued in production. Magnetic amplifiers were used on various schemes, including machine controls, and frequency and voltage regulating systems. Further h.f. induction heaters were developed during the year.

The demand for industrial motors was maintained throughout the year and British Standard dimensioned machines continued to be sold in quantity. Substantial orders were received from the machine tool, mining, chemical, and textile industries.

A number of coal washeries of the N.C.B. have been equipped with motors, examples being Wardley and Westoe Collieries in the North Eastern Division. Considerable quantities of machines were supplied in connection with extensions to various refineries.

The volume of business received for f.h.p. motors reflects increased activity by manufacturers of consumer goods and by the light engineering industry in general. There have been various new developments during the year, an interesting example being a 500 W, 1,000 c/s motor alternator set for use with radar equipment.

New instrument models and shunts were introduced during the year, for both switchboard and panel-mounting, as well as new portable designs for use in laboratories and in industry generally. Among these are the rotary synchroscope, tap position indicator, two types of temperature indicator for use with thermocouples and resistance elements respectively, and a pocket-sized phase-rotation indicator.

Also introduced were various precision grade portable ammeters, voltmeters and wattmeters and many other instruments for the remote electrical indication of positions, liquid levels, directions, speeds and revolutions, or any function thereof. Concurrently, a new range of 8in instruments was produced, to match the existing smaller sizes.

Alpine Transmission Line

A 220 kV transmission line erected from Avise to Turin, Italy, rises to an altitude of 2,896 metres and is thus one of the highest in Europe. Some 26 km of the line has been constructed at more than 2,000 m above sea level. Its purpose is to transmit to Piedmont the output of a large new power station built at Avise, in the high Aosta valley, and to facilitate exchanges of power with France and Switzerland.

Expansion in Southern Rhodesia

Electricity Supply Commission's Report for 1953-54

FROM A CORRESPONDENT

ALTHOUGH the Federation of the Rhodesias and Nyasaland has for more than a year been an accomplished fact, the report of the Electricity Supply Commission of Southern Rhodesia for the twelve months ended 31st March last is still confined to that territory. When either the Kariba Gorge or Kafue hydro-electric schemes is linked up with the Southern Rhodesian system it will be possible to judge the continued possibilities of the territory as a market for power and to mark the increase in consumption.

Graphs in the report show the tremendous developments that have taken place. Sales in 1953–54, the eighteenth year of the Commission's operations, increased by 13·1 per cent to 467·1 million kWh—seven times the 1940 consumption. Of the total output, 258·1 million kWh was disposed of in the area of the Central Undertaking, which covers the districts of Gwelo, Que Que, Gatooma, Hartley, Selukwe and Salisbury. The mining industry took 111 million kWh, other industries 51·5 million, farming about 13 million and domestic and lighting consumers 12·5 million. These figures give a cross section of the type of consumers. In the Western Undertaking—Bulawayo and Gwanda — mining and industrial consumers took 92 million out of the 98 million kWh consumed in the area.

For the introduction of a power supply system of 6,407 route miles at all voltages Southern Rhodesia has to thank the highly mineralized nature of the country, which alone has made it possible to create such an extensive supply system, to the great benefit of the whole country. The mines situated throughout the country account for some 232 million kWh out of the total of 467 million sold. This proportion, however, was substantially less than in 1940, when mining consumers purchased 88 per cent of the 60 million kWh sold, reflecting the improved diversity. Considering that the white population numbers only 159,000 and that there are only 535,000 natives at work, of whom 199,000 are employed on farms, the rate of consumption must be considered high, especially as at present there are no electric railways. Considerable extensions were made to the 88 kV transmission system and a total of 342 miles of line at this voltage is now in operation.

Power Plant Extensions

With regard to power station operation it is interesting to note that Shabani power station, supplying all classes of consumers in an undertaking that is not interconnected, had an annual load factor of 63·95 per cent. One new 20 MW set was installed at Umniati power station. The thermal efficiency of the Commission's stations (on kWh sent out) ranged from 20·82 per cent at Shabani " II " to 12·18 per cent at Umtali " I." The cost of coal per short ton varied from 30s 7d (Gwelo) to 39s 10d (Umtali), the average B.Th.U./lb being 12,690. The capacity of plant in operation at 31st March last was 109·8 MW and that under construction or on order was 75·1 MW. One 20 MW unit was brought into service in the Umniati station and arrangements have already been made for the installation of 60 MW of additional plant in the same station. The number of Europeans employed by the Commission increased by 26 to 557 and that of Africans to 2,338, but there is always a demand for more skilled workers.

In the sphere of rural development, the Commission has continued with its policy of electrifying as many farms as possible, the number supplied now standing at 2,032. There then follow in the report remarks which occur in those of most undertakings concerned with rural development. While the rise in the aggregate farming consumption of 30 per cent to 19 million kWh is considered reasonably satisfactory, far too many farms are said to restrict the use of electricity to residential requirements and even in this category they are often comparatively poor consumers, measured by urban standards. Many dairy farms are, however, large users of electricity.

Farm Supplies

By English standards the average annual consumption of farms in Southern Rhodesia, at 9,330 kWh, is high and it must be appreciated that only farms of over 50 acres are included. Against this, however, the majority of farm consumers have one point of supply and erect their own low voltage network which, in some cases, supplies two, three or even four houses and may consist of over a mile of line.

	1953/54	1952/53	Difference
Total revenue	£1,834,919	£1,530,096	+ 19·87 per cent
Total production costs (including capital charges	£1,913,915	£1,526,368	+ 25·39 per cent
Balance	Dr.£78,996	£4,328	— £83,324
Average price per kWh sold ...	0·884d	0·841d	+ 5·11 per cent
Average revenue per kWh sold ...	0·943d	0·893d	+ 5·60 per cent
Average cost per kWh sold ...	0·983d	0·891d	+ 10·33 per cent
Coal consumed in own generating stations (short tons)	289,234	265,782	+ 8·82 per cent
Cost of coal consumed (including railage)	£485,225	£378,771	+ 28·11 per cent
Sales of electricity, million kWh ...	467·1	411·2	+ 13·6

Expenditure on capital account during 1953–54 amounted to nearly £3 million, which brought the capital expenditure as at 31st March up to over £16 million. Treasury advances during the year amounted to just under £3 million, of which £1·9 million was drawn against a loan by the International Bank for Reconstruction and Development. Drawings against this loan now total £4 million, leaving £1·4 million available for the current financial year. The year's operations resulted in an excess of expenditure over revenue of £78,996. This, together with a change in the procedure for the redemption of Government loans, has made it necessary to apply for increases in most tariffs, averaging 25 per cent.

The total revenue for the year was £1,834,919, an increase of £304,223 (19·87 per cent), but production costs, including interest, etc., amounted to £1,913,915 (an increase of 25·39 per cent). The average cost per kWh was 0·983d, as against 0·891d in the previous year, the average gross revenue (including accrued and sundry revenue) being 0·943d (0·893d). After bringing in certain sums previously set aside, the loss of £78,996 was reduced to £5,802. It should be mentioned, however, that of the total loss, £47,698 was incurred in the Umtali undertaking,

making altogether £100,662 in three years. This must be attributed to a very worthy but costly attempt on the part of the Government to develop the potentialities of the Umtali district, by the erection of a network of transmission lines in a very sparsely populated, and not very industrialized area. The transport of coal from Wankie to Umtali, a distance of 660 miles, or 160 more than to Salisbury, is reflected in the cost of coal at Umtali, £60,129, against a revenue of £161,000 compared with the relative figures, £267,794 and £1,009,034 at Umniati station.

These comments are made in the hope that some of the firms interested in water power development in the Zambesi area will one day visit the Umtali district, which is extremely hilly and has a rainfall of well over 40 inches, and in some cases equal to that of the Snowdon area of North Wales.

Developments pending in the not far off future, Kariba, Kafue and Shire River, now come within the province of the Federal Minister of Commerce and Industry. The report drawn up by consultants of Electricité de France has been presented to Parliament and before the end of this month copies should be available to the public.

Valves for the Services and Industry

Development Work Described

CONCURRENTLY with the rapid growth of the electronics industry there has been a large demand for thermionic valves as evidenced by the fact that in this country alone the valve output has trebled in the last ten years. Much of this output has been absorbed by the expanding television market, but there is a significant rise in the industrial use of valves which is likely to continue because of the many recent advances in the scientific and industrial fields of electronics.

In addition, the need for self-preservation and the continued developments in the Services have shown that electronic devices are a necessity with the modern conception of war. Yet at the start of World War II the valve was just a useful adjunct. The vastness of the change is best illustrated by examples. The value of the electronic equipment in the latest type of flotilla leader destroyer approaches 100 times that of its 1940 counterpart, while a battleship has a valve complement of 9,000. The electronic equipment in a modern aeroplane costs nearly as much as the complete airframe. The 1940 fighter had 20 valves while the latest ones have 600, and a modern bomber needs 2,000 valves to function efficiently.

The quality standard of the valve designed and made to meet the modest requirements of domestic receivers has been the only one generally available for military and industrial uses, and it is therefore not surprising that the average operational life of such equipments per valve fault has been measured in very small numbers of hours. Requirements for better quality valves have arisen from manufacturers of computing equipment, civil aviation organizations and Government sources. Pressure from these bodies has resulted in the setting up of major programmes of development of "reliable" valves in both the United States and Great Britain. The large-scale effort in this country dates back to 1949, when the Government placed development contracts for the design of "plug-in" replacements for valve types on the Preferred List. Subsequent contracts for the development of new types have called for these to be "reliable" *ab initio.*

In a paper entitled "Thermionic Valves of Improved Quality for Government and Industrial Purposes," by Messrs. E. G. Rowe, P. Welch and W. W. Wright (all of Standard Telephones & Cables, Ltd.), which was read at a Radio Section meeting of the Institution of Electrical Engineers in London last week, the principal facets of thermionic valve reliability are embraced. It begins by defining the various types of reliability requirements and then deals with the authors' own work in designing and manufacturing "reliable" valves with the objective that they shall give trouble-free service under conditions of vibration and shock. Emphasis is given to the importance of the contribution of other component makers and of close liaison between valve maker and circuit designer if maximum circuit reliability is to be obtained.

"New Homes for Old"

Renovations Qualifying for Grants

REFERENCE has already been made in the *Electrical Review* to the Government's offer of financial grants for the renovation of old houses under the Housing Repairs & Rents Act, 1954. Now the Ministry of Housing & Local Government has published (through the Stationery Office, 3s 6d) an illustrated brochure "New Homes for Old: Improvements and Conversions."

This sets out in some detail the conditions governing grants and the means of obtaining them. Owners' obligations are stated and the question of increased rents, with which the grants are bound up, is discussed. Illustrated examples are given of improvements and conversions for various types of houses.

Certain standards are laid down for qualification for a grant. Among the specified requirements are that when the work is completed the house will have each room properly lighted and ventilated; be provided with efficient and adequate means of supplying hot water for domestic purposes; be provided in each room with adequate points for gas or electric lighting (where reasonably available); be provided with adequate facilities for heating; and have satisfactory facilities for storing, preparing and cooking food.

There is a chapter giving technical advice in which the following points are noted. Where cooking is done by gas or electricity a solid fuel appliance is usually desirable for space heating and hot water. Avoidance of long runs is of importance in hot water systems; long secondary circulations are to be avoided, particularly where electric immersion heaters are fitted in the hot water cylinder. Where hot water is provided from a solid fuel appliance, electric immersion heater or gas water heater, any *one* of these methods is eligible for grant; the cost of installing a supplementary appliance is not eligible for grant.

It is desirable that existing electrical installations should be examined and reported on by a competent electrician. Proposals for bringing the installation up to the required standard, or for a complete new installation, should be discussed with the local Electricity Board to determine whether a supply can be made available on acceptable terms, and the amount of the service connection charge, if any.

Hints are given on consumers' control units and meters and on wiring systems. It is emphasized that if too few socket outlets are provided tenants may use improvised and unsafe methods of connection such as the indiscriminate use of socket adaptors and connections to lampholders. Attention is drawn to the advantages of socket outlets of the all-purpose fused-plug type and to the savings which can be achieved by their use on the ring circuit system. Separate circuits are preferable for immersion heaters. The desirability of following the I.E.E. Regulations and the relevant Codes of Practice (which are quoted) is pointed out. Mention is also made of the lists of approved appliances issued by the British Electrical Development Association.

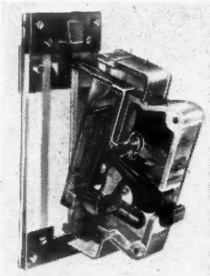
In dealing with cooking, the brochure says that no grant is payable in respect of removable fittings. A movable gas or electric cooker is normally provided by the tenant and does not rank for grant. The same applies to a portable washing machine. With these qualifications, the cost of providing the necessary gas or electric services for cooking and washing rank for grant.

NEW ELECTRICAL EQUIPMENT

Miniature Circuit Breakers

A new range of "Lupus" miniature circuit breakers, weighing only 6 oz, is announced by the M.C.B. Co. (MANCHESTER), LTD., 6, Melrose Avenue, Brooklands, Sale, Manchester.

The breakers incorporate a self-contained arc chamber, rolling/wiping contacts with integral arcing tips, and a magnetically assisted thermal trip which affords correct protection under all conditions of operation and is self-compensated for ambient temperature effect. The two-member mechanism and overload protection unit are enclosed in a sealed case, which is completely interference-proof. The overall dimensions are 4½in by 1in by 3in (projection). Wiring has been made easy by the provision of universal cable terminals, suitable for front or back connection, and the fixing holes and terminals are enclosed by self-locking end covers.



"Lupus" miniature circuit breaker

The breaker is available in standard ratings of 2·5, 5, 10, 15 and 30 A, and the price is £1 1s 4d. Non-standard ratings can be supplied, 20 per cent extra to list price.

Rectangular Oscilloscope Tube

In radar and oscilloscope displays, it often happens that only a small horizontal strip in the centre of the screen of a cathode ray tube is occupied by the trace. If instead of a conventional circular face a face of rectangular form is used, the trace can occupy the whole of the working screen area. Such a rectangular screen has been adopted in the new DG16-21 tube made by MULLARD, LTD., Century House, Shaftesbury Avenue, London, W.C.2. It is the first British tube of its kind and it has a screen size of 5½in by 1½in. The deflection sensitivity is of the order of 0·2 mm/V. The angle alignment between X and Y plates is kept within one degree of the nominal value of 90 deg; this close tolerance ensures the high degree of perpendicularity necessary where accurate measurements have to be made. The tube has a 6·3 V heater, and would normally operate at a final anode voltage of 6 kV.

Mullard DG16-21 rectangular faced oscilloscope tube

Vacuum Cleaner

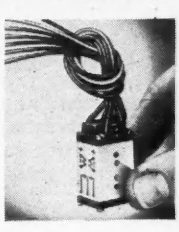
Recently introduced into this country by FRIDOR (G.B.), LTD., 66, Victoria Street, London, S.W.1, the "super de-luxe" "Fridor" vacuum cleaner has eight accessories, including two chromium plated extension pieces. Among other tools are two swivelling nozzles, a corner tool and a furniture brush. It is provided with 17ft of rubber flexible and the price is £14 3s 2d plus £5 5s 10d purchase tax in the United Kingdom.

"Fridor" "super de-luxe" vacuum cleaner

Miniature Moving-Coil Relay

The miniature moving-coil relay made by ELECTRO METHODS, LTD., Caxton Way, Stevenage, Herts, consists of a balanced moving coil in the field of a permanent magnet. The coil has a contact leaf which operates between two adjustable contact springs mounted on the fixed frame. The coil assembly moves to one side or the other and appropriate contact is made according to the direction of the controlling current. The coil has two independent windings which can be wired singly, in series, in parallel or in differential according to the application.

The relay fulfils the need for a magnetically self-shielded unit capable of operating from a power input of 10 μW and being of balanced construction functions efficiently in any position. The overall dimensions are 1⅜in by ¾in by ⅝in. The contacts are platinum and may be employed to control a non-inductive load providing that the a.c. or d.c. values do not exceed 50 V, 100 mA and 2 W. The relay is supplied in two models, Type 415 with coils having a resistance of 100 Ω and Type 416 with coils of 350 Ω.



Electro Methods small moving-coil relay

Sealed Relay

The latest addition to the range of relays produced by MAGNETIC DEVICES, LTD., Exning Road, Newmarket, is a version of their existing Series 595 relay. This, known as the 595H, is both hermetically sealed and of plug-in design on an octal base. The principal dimensions are 2⅝in high overall by 1 1/16 in diameter, while the weight is 3¼oz. Available with single and two pole changeover contacts, this relay should find many applications.

Magnetic Devices sealed relay

Portable Pump

In describing the BRITISH CENTRAL ELECTRICAL CO.'s "Flux 300" model EX-N portable pump in last week's issue the length of the pump was given as 27in. This measurement is in fact the length of the lifting tube, the overall length, including the pump, being 3ft 7in.

ELECTRO-MEDICAL APPARATUS IN CEYLON

A report issued by the Board of Trade Export Services Branch on the market for electrical apparatus in Ceylon (Ref. E.S.B. 27589/54) states that the volume of trade is increasing gradually but the prospects of its reaching reasonably substantial proportions are not yet encouraging. *Ad valorem* rates of import duty are: Preferential, 20 per cent; general, 30 per cent. No other levies are imposed. There is no restriction on imports of electro-medical apparatus and there are no Government regulations or standards to which imported apparatus is required to conform. The present extent of the market is very limited, the only equipment in use at present being X-ray apparatus, electro-cardiographs, short wave diathermy machines and electro-encephalographs.

Seventeen of the 260 State hospitals are now equipped with X-ray installations. There is no local production of electro-medical apparatus in Ceylon. The nature of the demand does not warrant the employment of energetic canvassers to sell such apparatus. United Kingdom equipment enjoys a sound reputation for trouble-free service.

Engineering in Europe

Abstracts from Foreign Technical Journals

THE adverse effects of oxidation on transformer oils are reduced heat dissipation, mechanical deterioration of the insulating materials and reduction of their dielectric strength. These alterations were investigated in long-time tests (eight months) on four specimens of oil, three of which consisted of fresh oil, and one of oxidized oil of the same type, at a temperature of 150 deg C. Two of the fresh-oil samples were in contact with air, the third was protected by a nitrogen cushion. It was found that the nitrogen protection is the only means available of conserving the purity and initial viscosity of the oil and of preventing sludge deposition and chemical attack on other insulating materials such as kraft paper and cotton, by the decomposition products of the oils. The role of the acid value of the oil in these processes is still difficult to assess, because its effects are marked by the thermal disintegration processes in the solid insulants which take place even in a neutral oil. A number of regenerative treatments for oils are known, but obviously these involve draining the transformer tanks and replacement of the old oil by fresh oil, and cannot undo damage caused to the solid insulation. Some types of nitrogen supply installations for transformers are described and illustrated in the article.—"Experimental Investigation of the Behaviour of Transformer Oils in the Presence of Air and Nitrogen," G. H. Perrin, *Bull. Soc. Franc. Elect.*, 7th Ser., Vol. 4, No. 46, pp. 607–611, 1954, in French.

Transformer Fault Detection

The impulse testing of transformers involves certain risks for the transformers so tested, viz. that damage is caused by the test itself without the certainty of its being discernible on oscillograms made during the tests. This danger is particularly great when the tests are made with chopped waves. Between 1944 and 1954 Hagenguth and Meador developed improved methods working with current measurements on a resistance inserted between the neutral of the tested transformer and earth. These measurements are repeated with reduced impulse voltages (to 50 per cent and even 20 per cent) and the comparison of the oscillograms permits, in favourable cases, the detection of faults caused by the test with 100 per cent impulse voltage.

The author's system improves on Hagenguth's method by carrying out parallel tests on the tested object and on an identical apparatus for comparison. This is carried out by two impulse generators charged to the same voltage of opposite polarities. The currents passing through the common measuring resistance should thus (at least very nearly) compensate each other if the tested object remains undamaged; otherwise a measurable difference current indicates damage done to the tested object. This method was found very suitable in the case of instrument transformers, radio components, etc., where there are no difficulties in providing pairs of identical apparatus.

In the case of the greatest interest, viz. that of very large transformers, twin apparatus will be rarely available, but the author presents oscillograms showing the clear advantages of the method in testing instrument transformers up to 150 kV. An alternative detection method based on the electromagnetic coupling between transformer primary and secondary windings was presented by R. Elsner in the discussion of the paper.—"A New Method of Fault Detection by Impulse Testing of Power and Instrument Transformers," W. Rabus, *VDE-Fachberichte*, Vol. 17, pp. 1–8/I, 1953, in German.

Locating Buried Cables

A simple apparatus for locating and identifying buried cables is presented. Since it is based on the principle of the direction finder, the equipment consists of signal generator, search coil (frame aerial) and amplifier-receiver with headphones. Where possible, the cable to be identified is disconnected and one of its ends connected with the signal generator, the other to earth. The signal generator may in the simplest case be a buzzer operated by a dry battery, connected to the cable via a small transformer, or else a valve-generator producing a signal frequency of 300–500 c/s. The other terminal of the connecting transformer must be earthed so that the return path is reliable through the earth and not through the sheath of the cable to be identified or those of neighbouring cables.

To improve the chances of identification in difficult cases the signals are keyed in a chosen rhythm either by a small electric motor or by a clockwork mechanism. The location and identification is by the methods known from direction finding, i.e. adjustment of the search coil in positions of maximum and minimum sound in the headphones. By the use of small search coils instead of the frame the depth of the cable below the surface may also be established.—"Apparatus for Locating Buried Cables and for Selecting Specified Cables Laid in the Same Duct," K. Buchmann, *A.S.E. Bull.*, Vol. 45, No. 20, pp. 838–841, 1954, in German.

Impulse Insulation Levels

A method of selecting the impulse insulation levels for divertor-protected single- and double-ended 400 kV substations is presented. The method is based on an evaluation of a curve of permissible maxima of atmospheric surge voltages obtained as envelope of atmospheric surge waves (from oscillograms) of varying front steepness. The most important amplitudes are those 2 and 8 μsec after the arrival of the surge wave, by analogy with the typical form of the volt-second characteristic of the insulation. For 400 kV transformers the relevant values are $U_2 = 1{,}750$ kV and $U_8 = 1{,}400$ kV and for switchgear, 1,875 kV and 1,500 kV, respectively.

For practical reasons the impulse testing voltages will be assumed in both cases as 1,875 and 1,500 kV, respectively. These values consider the generally adopted principle of reducing, for obvious economic and technical reasons, the relative safety factors at very high operating voltages, while still leaving a reasonable safety margin. A further reduction of the margin cannot be recommended because the theoretical safety requirement for 400 kV installations is of the order of 200–300 kA (assuming the tower foot resistances to be 9–6 ohms). The results have been verified by model tests in which the danger spots of substations of various types were also determined. It is clear that such tests on specialized models should be made before the final design of any 400 kV installation is decided upon.—"Choice of the Impulse Insulation Level for 400 kV Switchgear and Transformers," M. V. Kostenko, I. F. Polovoi and A. N. Sherentsis, *Elektrichestvo*, No. 8, pp. 31–36, 1954, in Russian.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

VIEWS on the NEWS

By REFLECTOR

A CALL to his members to interest themselves more in Association affairs is made in a New Year message from Mr. A. F. Plummer, president of the Electrical Contractors' Association. I particularly like the passage in which he says:—

> "I know that meetings, whether they be of Associations as a whole or at branch level, always occur on a day when it is difficult to get away—unlike Cup-Ties, which come on days which are usually free—but do try to attend, as the success of your Association is based on the fact that every member has a voice in the conduct of its affairs."

As in national affairs, too many constituents are apt to complain of the way in which things are run without attempting to do anything constructive about it. Democracy and inertia too often go together.

* * *

Announcing an increase of sixpence a week in the domestic tariff fixed charge, the Eastern Electricity Board said that this was "roughly equivalent to half a cigarette a day." This method of measuring increased charges is becoming far too popular. In point of fact the rises in prices put over in this way must now amount to the equivalent of several packets of cigarettes a day. Another point is the flat sixpenny increase. It probably makes for easier book-keeping but it means that some consumers will pay a higher proportional extra amount than others and they may well ask why. Of course I must admit that the others will be quite satisfied, that is, if anybody is ever satisfied about increases. The extra charges themselves are amply justified as the Board shows by comparing the small rise in the cost of electricity with the large price increases in other directions.

* * *

Those who recall the odours which prevailed in the London Underground Railways some years ago, particularly on the old City and South London line, will appreciate the experiments now being conducted in the Paris Métro. The idea seems to be to use different perfumes to sweeten the air of the various lines; eau-de-Cologne for the Vincennes-Neuilly route and pine on the Orléans-Cligancourt line are mentioned. The perfume is automatically sprayed from the trains as they enter stations. I think that Londoners will prefer to continue with the present smell of warm flat irons which pervades the London Underground.

* * *

Radio-telephony is regarded, quite reasonably, as suitable for communication over distances—generally long ones. There is the other application of communication between moving points for which wired telephony is not suitable. What I believe to be an innovation is the use of radio-telephony in the operation of tower cranes. Some modern cranes working on high buildings often have to place loads in positions out of the range of the driver's vision. Directions can be shouted from the building to the driver but this carries a risk of mishearing and in high winds or noisy situations is entirely inadequate. Hand signals are resorted to but these, too, are subject to misinterpretation. On a building estate in South London, where eleven-storey flats are being erected, three cranes with a reach of over 150 feet are now being controlled by means of Pye radio equipments each employing a different frequency. A man who can move freely about the ground passes on instructions to the crane driver and the system is said to work very well.

* * *

A Member of the House of Commons (Sir Jocelyn Lucas) complained recently that there was inadequate heating in the Palace of Westminster and referred to an electric fire in the Members' Writing Room which had no "heater." I commented on this a couple of weeks ago and as a result I have had a letter from Mr. Raymond Berry who tells me that there are imitation coal fires of his company's manufacture in the majority of the principal rooms at Westminster. Some have heating elements, but others are there purely for decorative purposes and to brighten the beautiful fireplaces which grace the rooms. It was not one of the non-heating type to which Sir Jocelyn Lucas referred apparently, for the Parliamentary Secretary to the Ministry of Works said that the fire could raise the temperature of the room from 69 deg, at which it was kept by central heating, to 75 deg. I would rather have the decorative effect of the fire alone in these circumstances.

* * *

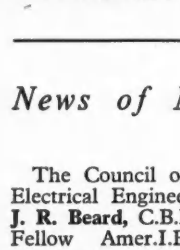
Eighty years ago the Royal Institution Christmas Lectures, "adapted to a juvenile auditory," were given by Dr. John Hall Gladstone, F.R.S., Fullerian Professor of Chemistry, Royal Institution. In a report of the first lecture published in the *Electrical Review* of 15th January, 1875, Dr. Gladstone is said to have told the children:—

> "During this course of lectures I shall have to introduce to you several pieces of apparatus worthy of all honour, and this large magnet is one of them. I do not mean that this is particularly valuable because it is very large, but because there are associations connected with it. It is not difficult to get a great magnet like this; you can buy one. But this particular magnet, which belongs to the Royal Institution, is one that has a history and a character. It was made long, long ago, by that great and good man—Professor Faraday; and so you are looking at his great electro-magnet—that with which he did a great deal of his very best work. He used to look at that magnet, and work with it, and imagine the forces which were revolving about it. To a certain extent it is clumsily made compared with the magnets made nowadays. It is, I believe, formed from one link of an enormous cable cut across, and these wires have been twisted round about it. It is, on a large scale, just like this little magnet of soft iron."

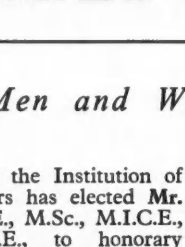
PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Council of the Institution of Electrical Engineers has elected **Mr. J. R. Beard,** C.B.E., M.Sc., M.I.C.E., Fellow Amer.I.E.E., to honorary membership of the Institution for his distinguished services to the profession, more especially in the field of the transmission and distribution of electricity and for his valuable services to the Institution. The Council has



Sir John Cockcroft



Mr. J. R. Beard

also made the thirty-third award of the Faraday Medal to **Sir John Cockcroft,** K.C.B., C.B.E., M.A., M.Sc.Tech., Ph.D., F.R.S., M.I.E.E., director of the Atomic Energy Research Establishment, Harwell, for the conspicuous services he has rendered to the advancement of electrical science, for his distinguished work in the field of nuclear physics and the development of power from nuclear sources.

It will be well known that Mr. Beard was closely associated with the design and construction of the national grid system; his name is also associated with numerous other power supply and traction schemes in this country and abroad. He has served on the panel of technical advisers to the North of Scotland Hydro-Electric Board since its formation in 1943. Mr. Beard was educated at Manchester Grammar School and Manchester University and he spent his post-graduate years with the Newcastle-upon-Tyne Electric Supply Co. and the Cleveland & Durham Electric Power Co., later joining his present firm, Merz & McLellan, as assistant to Mr. P. V. Hunter whom he succeeded as chief electrical engineer. He is now senior partner of the firm.

Mr. Beard has performed oustanding services for the Institution. He was elected chairman of the North-Eastern Centre in 1920, and in 1927 and again in 1934 he was elected a member of Council. He first took office as vice-president in 1937 and served as president of the Institution in 1940. He has always shown particular interest in the affairs of the local Centres and the Overseas Committees and Branches and has served as chairman of the Local Centres and the Overseas Activities Committees of the Council. He has written numerous papers for the Institution and has twice been awarded the Institution Premium. He was chairman of the Electrical Installations Study Committee set up by the Institution for the Ministry of Works and was associated from its inception with the Council for Codes of Practice for Buildings. He was president of the Association of Supervising Electrical Engineers from 1938 to 1940 and in 1945 he was elected chairman of the Association of Consulting Engineers. Last year he was president of the British Electrical Power Convention.

Sir John Cockcroft served on the Council of the Institution from 1942 to 1945. He was educated at Manchester University and received his practical training as a college apprentice with the Metropolitan-Vickers Electrical Co., Ltd. After serving on the company's research staff under Sir Arthur P. M. Fleming he was appointed in 1927 as consulting physicist to the company. In 1930 he was appointed University demonstrator and lecturer in physics at the Cavendish Laboratory, Cambridge. Here, under Lord Rutherford, he developed apparatus for producing high velocity positive ions, with which, in 1932, he and E. T. S. Walton were the first to disintegrate the nucleus of an element by the use of artificially accelerated protons. In 1939 Sir John succeeded Sir Edward Appleton as Jacksonian Professor of Natural Philosophy. Throughout the war years he was in demand as adviser to many Government Departments. He held the post of director of the Air Defence Research and Development Establishment (later R.R.D.E.) of the Ministry of Supply at Christchurch and Malvern and subsequently that of director of the Montreal Laboratory of the National Research Council of Canada. He received his present appointment in 1946. Among other awards he has received the Hughes Medal of the Royal Society, the Hopkins Prize of the Cambridge Philosophical Society, the Ewing Medal of the Institution of Civil Engineers, the U.S. Medal of Freedom, the Nobel Prize for Physics and most recently (1954) the Royal Medal of the Royal Society. He has published numerous papers on nuclear physics in the *Proceedings* of the Royal Society and on electrotechnology in the *Proceedings* of the Institution. In 1936 he delivered the Thirty-Seventh Kelvin Lecture on "The Transmutation of Matter by High Energy Particles and Radiations." In 1953 a symposium of papers on "Nuclear Reactor Instrumentation" at I.E.E. was preceded by a lecture by Sir John on "Nuclear Reactors and Applications."

Mr. D. L. Davies, B.Sc. (Hons.) Wales, Graduate I.E.E., was appointed chief electronic engineer of Winston Electronics, Ltd., on 1st January. He joined the company as one of several senior engineers at the beginning of 1954, and he has been particularly responsible for the design and development of the first pre-launch guided missile test gear. He was a pupil at Swansea Grammar School and from 1945 to 1948 he studied at University College, Swansea. For three years he was a lecturer in electrical engineering at Edinburgh University. He was employed by E.M.I., Ltd., and then by the English Electric Co., Ltd.

Mr. R. B. Pullin, O.B.E., chairman, and **Mr. P. J. Ellis,** O.B.E., managing director, of R. B. Pullin & Co., Ltd., left London Airport on 11th January for the United States. They will visit New York, Chicago and Los Angeles and will sail for home in the *Queen Mary* on the 26th January.

Mr. C. F. J. Francis-Carter, O.B.E., has been appointed managing director of the Aluminium Wire & Cable Co., Ltd. He has been general manager of the company since its inception in 1947.

Mr. John MacMahon, J.P., has resigned from the board of Telephone Rentals, Ltd., on account of ill-health.

Mr. C. H. Jordan

Mr. C. H. Jordan, sales manager of Hague & McKenzie, Ltd., has been elected to the board of directors, with special reference to sales. Mr. Jordan joined the company in 1946 as a representative and became sales manager in 1952.

Mr. D. Thomas, previously with Hubert P. Trist, Ltd., of Bristol, has now joined the sales staff of C.A.V., Ltd.

Mr. G. A. Cheetham has been appointed chairman of the Switchgear Testing Co., which has now become part of the Metropolitan-Vickers group.

Mr. H. P. Pentelow retired at the end of last year after fifty-one years' service at the Trafford Park Works of

Lancashire Dynamo & Crypto, Ltd. Practically the whole of his service has been devoted to the electrical application of heavy machine tools—particularly the electrical driving of planing machines.

The Northern Ireland Minister of Commerce has made the following appointments as members of the Electricity Board for Northern Ireland for the two years ending 31st December, 1956:—

Mr. J. Walker, F.C.A. (chairman); **Major C. A. M. Alexander,** M.C., D.L.; **Mr. A. G. Algeo,** C.B.E.; **Mr. W. A. Mullen,** D.L.; **Mr. J. R. W. Murland,** B.Sc., M.Cons.E., M.I.C.E., M.I.Mech.E., M.I.E.E. and **Mr. A. Shiells.** The composition of the Board is the same as for the two-year period ended 31st December last, except that Mr. Murland, an electrical consultant, has been appointed as an additional member.

In the list of names of electrical men included in the New Year Honours List given in our last week's issue we should have mentioned **Mr. E. Cassleton Elliott,** F.S.A.A., chairman of Kerry's (Great Britain), Ltd., who becomes a C.B.E. We noted the awards of M.B.E. to **Mr. W. Geary,** assistant superintendent, Plant Department, Metropolitan-Vickers Electrical Co., Ltd., and **Mr. D. Dunsmore,** superintendent of the electrical machines division, Brush Electrical

Mr. D. Dunsmore

Mr. W. Geary

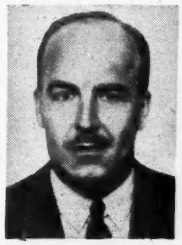
Engineering Co., Ltd., and we now reproduce the portraits of these two gentlemen.

Sir Samuel Brown, a director of Sangamo Weston, Ltd., has been appointed chairman of the company in succession to **Mr. S. B. Rogers,** who has resigned from the board.

Mr. W. T. Hooker has resigned from F. H. Wheeler & Co., Ltd., to take up the appointment of London manager to J. A. Brown & Partners, Ltd., 123, Warwick Road, London, S.W.5 (telephone: Fremantle 5546).

Mr. H. D. Drysdale has been appointed chairman of Morphy-Richards, Ltd., in place of **Mr. G. Wansbrough,** who has resigned from the board for personal reasons.

Mr. R. H. Bannister, for the last ten years manager, Scotland and Ireland, for the English Electric Co., Ltd., has been appointed manager of the Home Branch Organization, and is now at the Stafford Works. **Mr. P. McNee,** formerly manager of the company's Edinburgh office, becomes manager, Scottish territories. **Mr. W. M. Todd,** now technical representative at the Cardiff office, and previously of the Bradford works and Glasgow branch, is appointed manager, Edinburgh office, under Mr. McNee, and he will commence his new duties on 14th March.



Mr. R. H. Bannister

Mr. P. McNee

Mr. W. M. Todd

Mr. L. C. Bingham, general sales manager of Venner, Ltd., will leave London Airport on 23rd January for a month's tour of South Africa. In addition to conferences with Venner distributors he will be demonstrating time switches and other of the company's products to the authorities of South African cities.

The Council of Birmingham University has approved the appointment of **Dr. T. L. Ibbs,** lecturer in physics to a personal Chair in the Department of Physics. He will assume responsibility for the administration of the department and this will leave **Prof. P. B. Moon,** head of the Department of Physics, free to concentrate his attention on the cyclotron and the synchrotron in the Department.

Professor A. Tustin has been appointed to the Chair of Electrical Engineering at the Imperial College of Science and Technology, London University, and will take up his new duties in August next. He succeeds Professor Willis Jackson, who resigned from the position in 1953 on his appointment as director of research and education with the Metropolitan-Vickers Electrical Co., Ltd.

Professor Tustin, who has been Professor of Electrical Engineering at Birmingham University since 1947, received his technical education at King's College, University of Durham, and his training with the Metropolitan-Vickers Electrical Co., Ltd., with which company he subsequently became assistant chief engineer at the Attercliffe Common Works. From 1934 to 1937 he was engaged by the Soviet Government as consulting engineer to the Moscow Dynamo Works, and from October, 1953, to May, 1954, he occupied the Chair of Electrical Engineering at the Massachusetts Institute of Technology during the reorganization at the Institute of teaching and experimental work in the field of heavy current electrical machines.

Mr. R. McL. Fairfield, B.Sc.(Eng.), M.I.E.E., M.I.Mech.E., M.Amer.I.E.E., has relinquished his position as general manager of W. T. Glover & Co., Ltd. We reported in our issue of 22nd October that Mr. Fairfield had been elected to the board of British Insulated Callender's Cables, Ltd., as director of production and engineering. **Mr. D. T. Hollingsworth,** M.I.E.E., M.Amer. I.E.E., a director of W. T. Glover & Co., Ltd., has been appointed general manager. Mr. Hollingsworth was recently appointed director and general manager of British Insulated Callender's (Submarine Cables), Ltd., and elected to the board of British Insulated Callender's Cables, Ltd.

Mr. D. T. Hollingsworth

The annual dinner of the West London Branch of the **Association of Supervising Electrical Engineers** was held on 1st January at the Clarendon Restaurant, Hammersmith. We reproduce a photograph taken on this occasion.

At the dinner of the A.S.E.E. West London Branch: Mr. J. H. Pendry, branch secretary, Mr. S. H. Harding, national chairman, Mr. Bryan Donkin, president, Mr. J. M. Harding, branch chairman, Mr. H. Clifton, immediate past chairman and Mr. E. A. Bromfield, general secretary

Some of the principal guests at the annual dinner of the Nottingham Branch of the Electrical Industries Benevolent Association, held in Nottingham on 8th January. Left to right: Mr. T. H. Greaves (past chairman), Mr. C. R. King (chairman, East Midlands Electricity Board), Mr. K. G. Wilson (chairman), Mr. P. M. Furse (treasurer) and Mr. S. N. Hind (secretary)

Mr. J. L. Rowbotham, M.I.E.E., managing director of Switchgear & Cowans, Ltd., has been appointed chairman of the company. Mr. Rowbotham has been associated with the company since 1937 when he took over the London sales on leaving the Hackbridge Electric Construction Co. He went to Manchester as general manager in 1940 and was appointed director in 1943, becoming joint managing director in 1950.

Mr. T. Allen has been appointed to the board of G. W. B. Furnaces, Ltd., and will be the administrative director in charge at the Dibdale Works, Dudley, where the head office, including the accounting section, is being transferred on 1st February. Mr. Allen joined the company in 1934, and has been general manager since 1948. **Mr. A. V. Francis** has been appointed chief engineer and will be in charge of furnace design and sales.

Mr. W. E. Warrilow, who is now settled in New Zealand after more than sixty years in the electrical industry here, tells us that he recently gave an address to the Hamilton Rotary Club on "Wind Power as a Source of Energy."

On 22nd December the annual presentation of long-service certificates and gold wristwatches was held at the Hollinwood Works of **Ferranti, Ltd.** Female employees who had served thirty years or more with the company were included for the first time. There were seventy-three of these who, with twenty-four male employees who had completed forty years' service, brought the total number of recipients of long-service awards since the scheme was instituted to 270. Lady de Ferranti made the presentations to the ladies and Sir Vincent de Ferranti to the men.

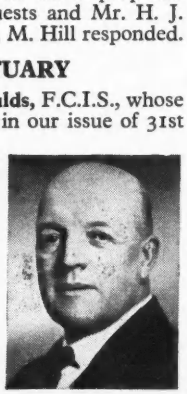
A reception was given recently by **J. H. Plant, Ltd.,** at the Empress Room, Horseshoe Hotel, Tottenham Court Road, London, when approximately 200 guests, comprising some of the company's clients together with its own staff, attended. This was the first occasion on which such a procedure had been adopted and it enabled clients to meet the entire administrative staff.

The Manchester Branch Social Club of the **Reliance Telephone Co., Ltd.,** held its annual dinner-dance and social at the Angel Hotel, Knutsford, on 4th December, the chairman being Mr. A. Bailey, branch manager, and the chief guests Mr. Silbermann (managing director), Mr. Keene (chief engineer) and Mr. and Mrs. Emery of the General Electric Co., Ltd.

F. Westerman (Wholesale), Ltd., held their annual staff dinner on 1st January at the Grand Hotel, Birmingham, fifty members of the staff and a few guests attending. The toast of the staff was proposed by Mr. F. Westerman, who said that he was starting that day a superannuation scheme to provide pensions and other benefits. Mr. P. Farrington, a representative, proposed the toast of the company, Mr. G. R. Stone proposed the toast of the guests and Mr. H. J. Gibson and Mr. N. M. Hill responded.

OBITUARY

Mr. Howard Foulds, F.C.I.S., whose death we reported in our issue of 31st December, was for twenty-six years secretary of the former Callender's Cable & Construction Co., Ltd. Mr. Foulds was educated at Alleyn's School, Dulwich, and was a well-known figure in electrical circles due largely to his secretaryship of Faraday House during the first decade of the century. He was afterwards secretary of the Birmingham Corporation Electric Supply Department and in 1918 became secretary of Callender's Cable & Construction Co., Ltd. He held this position until 1945 when he retired on the amalgamation of the company with British Insulated Cables, Ltd., to form the present British Insulated Callender's Cables, Ltd. He was a director of a number of electricity supply companies before their nationalization. Mr. Foulds was for many years on the Council of the Chartered Institute of Secretaries and later became its president. He was actively concerned with local affairs and was for some time chairman of the Caterham Urban District Council.



The late Mr. H. Foulds

Mr. W. Ogilvie.—The death occurred on 3rd January of Mr. William Ogilvie, M.I.Mech.E., M.I.P.E., technical director of B.S.A. Tools, Ltd., at his home, "Clova," The Heights, Worthing, Sussex. Mr. Ogilvie was educated at Monoux Grammar School, Walthamstow, and Parmitters School, Cambridge Heath, London, and served his apprenticeship with the British Thomson-Houston Co., Ltd., Rugby, before joining the B.S.A. group in 1910. After serving with the Daimler Co., he was appointed chief draughtsman of B.S.A. Tools, Ltd., in 1920, and subsequently held the position of chief engineer until his appointment as technical director in 1947.

Mr. R. O. Herford.—The death occurred at Buenos Aires on 2nd January, during a visit to the company's overseas agents, of Mr. Robert Osler Herford, O.B.E., a director of Renold Chains, Ltd. Mr. Herford was for many years managing director of the Renold & Coventry Chain Co., Ltd., Manchester, retiring from that office in 1953. His long service with the company and its predecessors began in 1909 when he entered the employment of Hans Renold, Ltd., as an apprentice.

Mr. W. V. Green.—The death occurred on 13th December, at the age of sixty, of Mr. William Victor Green, branch manager at Gloucester of British Insulated Callender's Cables, Ltd. Mr. Green joined the company in 1925 as a representative at the Cardiff office, and in 1931 he took charge of the newly-formed branch office at Gloucester. He was a member of Gloucester City Council.

Mr. J. P. Rice.—The death has occurred of Mr. J. P. Rice, manager of the B.T.H. Lamp and Lighting Depot at Blackpool. Mr. Rice, who was sixty-one, joined the company in 1932.

Mr. E. Anderson.—The death is reported from Winnipeg of Mr. Edward Anderson, who was president of the Winnipeg Electric Co. for some years until his retirement in 1940. He was eighty-eight.

Mr. Kaleb Hedin, founder of Hedin, Ltd., died on 4th January at the age of eighty-two. Before founding his company Mr. Hedin was works director of Asea Electric, Ltd.

Mr. A. Kelly, sales representative for the Midlands area of J. H. Tucker & Co., Ltd., died suddenly on 4th January following an operation. He was thirty-six years of age.

Mr. W. Gamble.—The death occurred in Manchester on 27th December of Mr. Wilfred Gamble, chief electrical installation engineer of W. J. Furse & Co. (Manchester), Ltd.

Low-Pressure Moulded Plastics

IN a paper on "Non-Metallic New Materials in Engineering," which he read before the Institute of Marine Engineers on 11th January, Dr. N. J. L. Megson (Ministry of Supply) gave particular attention to glass-fibre and asbestos reinforced plastics which can be moulded at much lower pressures than those essential for conventional plastics.

Plastics he defined as a special branch of high polymers, generally organic compounds of high molecular weight, which could be moulded by an external force usually at high temperatures. They could be either thermo-plastic or thermo-setting. The first could be repeatedly softened by heating and cooling to a solid state without chemical or physical change; they included "Perspex," polystyrene, polyvinylchloride (p.v.c.) and bitumen, all of which could be fabricated by casting, compression or injection moulding, extrusion and calendering. A notable example was the use of extruded polythene tubing for water distribution.

Thermo-setting polymers underwent an irreversible chemical change through being heated, causing infusibility and insolubility; their mechanical properties altered much less with change of temperature than did those of thermo-plastics and they were more important for structures. For most applications they required a strengthening filler such as cotton linters, rag or chopped string, asbestos (for heat resistance) or mica (for good dielectric characteristics). Laminated material, as used for rolling mill bearings and silent gears requiring only water for lubrication, was produced by fillers of resin-impregnated sheets of paper or cloth consolidated under heat and pressure. Impregnated sheets could also be wrapped on a mandrel and cured under heat to make tubes for electrical purposes.

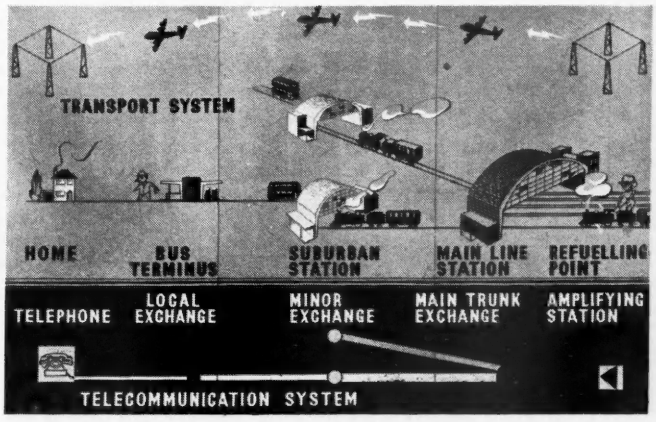
Moulding sizes had been limited by the sizes of the presses required to give 1 to 2 tons/sq in until the introduction in the U.S.A. during the war of "contact" resins. These resins could be heat- or catalyst-cured at atmospheric pressure with relatively cheap moulding equipment because they evolved no volatile products such as water. Glass fabric, being non-hygroscopic, was originally chosen as a filler, but the scope was widened after 1945 by the use of a less expensive filler of asbestos felt impregnated with a thermo-setting phenolic resin ("Durestos"). Its defect, adverse to low pressure moulding, of evolving water during cure was overcome by a vacuum-moulding technique devised by the Royal Aircraft Establishment for continual removal of water vapour through a porous vacuum (commonly glass cloth) within the mould. Moulding of "Durestos" filler (specific gravity 1·27) could be treated in three ways, depending on the strength necessary: at 160 deg C and 100 to 150 lb/sq in; at 160 deg C and 14 lb/sq in; and at "no pressure" with the addition of certain quick-setting resins. Broadly, the greater the fibre length of the asbestos the better the strength. Compared with steel, five times the thickness of plastic could be employed without increasing total weight. Specific properties of plastics and metals for structures were tabulated and their advantages and drawbacks were assessed.

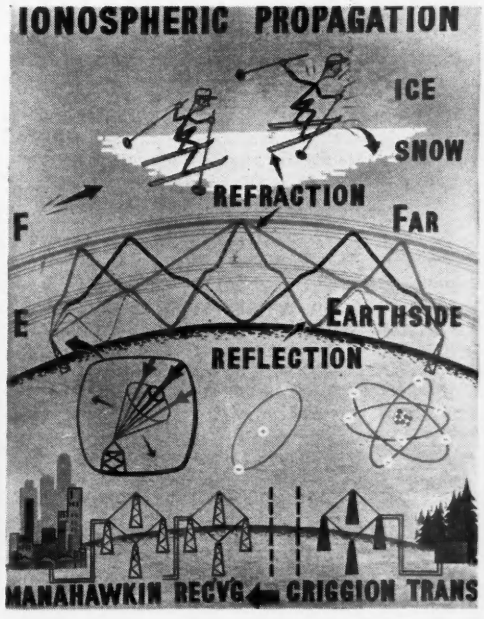
The Faraday Lecture

ON Thursday, 27th January, at 6 p.m., the Faraday Lecture, organized annually by the Institution of Electrical Engineers, is to be delivered at the Central Hall, Westminster, by Mr. T. B. D. Terroni, B.Sc., A.C.G.I., D.I.C., M.I.E.E., who has chosen for his subject, "Courier to Carrier in Communications." Admission is free, by ticket obtainable from the I.E.E. The lecture, which was first delivered at Liverpool on 6th December, 1954 (see *Electrical Review*, 10th December, page 935), opens with a few introductory remarks touching on the importance of communications in the development of mankind. A short cartoon film in colour, entitled "A Brief History of Communications," then traces the development of communications from the early times when the Egyptians carried tablets inscribed with hieroglyphics; then beacons, semaphore signalling and so on leading up to the development of the automatic exchange and the use of cables to replace overhead wires.

This leads up to the main subject, introduced by the operation of a 2-motion selector which is mounted on a large panel fitted with 100 lamps to represent 100 contacts on the switch. The dialling of different numbers

Below: This back cloth shows the analogy between communication and transport systems of the present day. Right: Analogies between the processes involved in ionospheric propagation





is displayed on the panel. The use of a magnetic drum which acts as a storage device is next demonstrated. A further demonstration employing a map illuminated by lamps along the various routes radiating from London to the different Centres of the Institution, gives a display of the way in which alternative routes can be selected between London and, say, Dundee, with the aid of a magnetic drum, when the normal route is blocked by excessive traffic or failure from any cause. By dialling to a variety of Centres the framework of a typical national trunk dialling scheme becomes apparent.

A large backcloth is used to show an analogy between communication systems and transport systems of the present day, and the next step is the development of multi-channel communications simultaneously over one circuit. Consideration is then given to the developments which have taken place in cable circuits up to high frequency waveguides. This is followed by an explanation of propagation through the ionosphere with radio waves accompanied by specially prepared coloured pictures to show analogies between the processes involved. A radio demonstration shows directivity of very short waves and the fading effects which are experienced in the ionosphere. The lecture ends with a documentary film which traces a telephone call from Birmingham to New York.

Recording Electrical Signals

IN the discussion on the paper entitled "Equipment of Instrumental Accuracy for Recording and Reproduction of Electrical Signals, Using Cinematographic Film," by H. McGregor Ross, M.A., presented at a joint meeting of the Measurements and Radio Sections of the Institution of Electrical Engineers last week and reported on page 21 of our issue dated 4th January, Mr. J. F. Coales (University of Cambridge) said that to simplify automatic control he felt confident that there would be a move towards non-linear controls, and on-off controls particularly would become more popular from the point of view of simplicity. He was a little concerned about the frequency response. For most automatic control problems 1,000 c/s was adequate, but in the computing field it was not adequate, and response at higher frequencies, say, about 10 kc/s, would be required. There might be some possibility of improvement in that direction. The use of flash-tubes to give more light might enable higher speeds to be run.

Mr. K. W. Thwaites (A.S.R.E.) said that the need for such equipment had been outstanding for some years and the uses to which it could be put were legion. He outlined a number of applications and advantages of the equipment, one being that it was possible to look at a specimen of the record before it was sent away for processing. The fact that it was a d.c. machine and had constant-amplitude response was very useful, because the opportunity was provided of applying any smoothing process desired on the data during the reading process and not during the recording process. That led to a wider range of treatment of data which could be applied.

Mr. W. Bamford (Everett Edgcumbe) referred to the problem of current faults on a transmission network and suggested that as faults did not occur on a network all at once, it might be possible to use a number of magnetic tape loops, strategically placed on the network, with one central recording film unit. The film could then be produced and dealt with in the way suggested by the author to produce a series of permanent records for the enlightenment of the power engineer. There would be a great advantage if the film could record up to, say, seven parameters.

In replying the author said that any gain of that sort always had associated with it a loss in another respect. What it would mean was that the tracks would have to be made narrower and almost certainly amplitude accuracy would go down by the factor of 2½. There was certainly a good chance of success in using the equipment under discussion in conjunction with other recording techniques.

Bridge Lighting Installation

THE new Northam Bridge at Southampton, recently opened by the Duke of Wellington, links the parts of the borough lying east and west of the River Itchen. Sodium lighting for the bridge has been provided by the General Electric Co., Ltd., the columns, made by Macfarlands, Ltd., of Glasgow, being of cast iron, zinc sprayed. The lanterns, each accommodating one "Osram" 140 W sodium lamp, are mounted on galvanized steel brackets giving a 9ft 6in overhang. At one end of the bridge a column is sited on the central reservation and carries two lanterns on a pair of shorter brackets. The G.E.C. Z9425 lantern, of which there are 39 in this installation, is an open type having a die-cast light alloy body and two prismatic refractor plates.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Factory Electrical Layouts

I HAVE read with great interest the article on "Factory Electrical Layouts," by Mr. R. Smillie, in your issue of 17th December, and feel that it should have a wider circulation, especially amongst architects, consulting engineers and industrialists. My experience gives me the impression that many of these people believe that they can plan and construct a factory on any site and then telephone the supply authority and expect a supply of anything up to 1,000 kVA to be made available the following week.

It might even be suggested to electricity supply authorities that a reprint of the article be sent to developers when information is gained from newspaper reports, etc., that a new factory is to be established.

Birmingham. E. C. COOPER, A.M.I.E.E.

Shortage of Technologists

THE editorial page of your issue of 17th December refers to the shortage of technologists and approves the decision of the Government to expand facilities for technical education at universities and existing technological institutions.

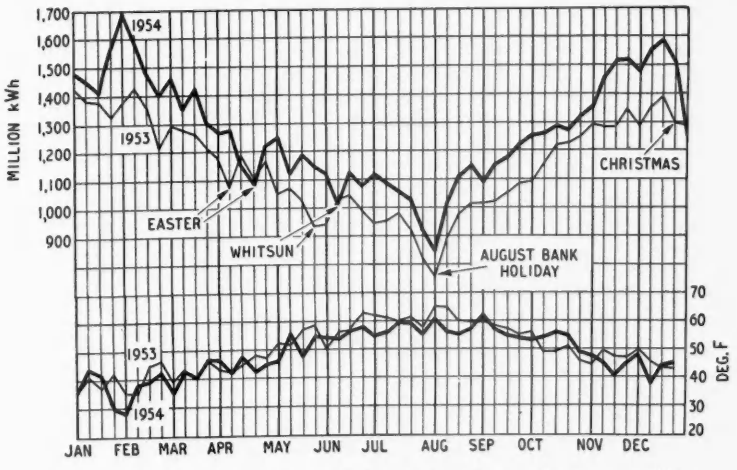
Side by side in the "Situations Vacant" columns of the same issue are advertised: (a) the post of 3rd assistant district engineer at a salary of £595-£640 per annum and (b) the post of showroom supervisor (male) at a salary of £605-£665 per annum.

So long as these conditions continue in the supply industry there is likely to be an acute shortage of well educated and well trained technologists entering the industry. D.J.C.

GENERATION AND DEVELOPMENT

Output and the Weather

The effect of the weather on electricity consumption is clearly shown in the accompanying graph which gives the weekly outputs of solid fuel fired stations in this country and the average weekly temperatures during the 52 weeks ended 1st January last. The Ministry of Fuel and Power's statistical statement records that for the period the total output was 66,425 million kWh, compared with 60,020 million in the corresponding period of the previous year, an increase of 6,405 million kWh (10·7 per cent). It will be seen that the highest weekly output coincided with the cold spell at the beginning of February and that throughout the summer, during which the average temperatures remained fairly consistently below those of 1953, there was a substantial increase in consumption.



Weekly electricity output from solid fuel fired stations and average weekly temperatures

Distributed stocks of coal at power stations at 25th December last, amounting to 5,463,000 kWh, were equal to 5·9 weeks' supply against the 6,067,000 tons (6·9 weeks' supply) of a year ago.

Overhead Lines on Dartmoor

The Dartmoor Preservation Association has expressed concern at a proposal of the South Western Electricity Board to erect overhead lines from Two Bridges to Postbridge and thence to Bellever. These would go over Littaford, Langaford and Higher White Tors and so interfere, says the Association, with what at the moment is a completely unspoiled view. It is stated that the National Parks Commission is taking the matter up.

Welsh Water Power Development

Assurances were given last week by representatives of the British Electricity Authority to members of local bodies that in the construction of the Blaenau Ffestiniog hydro-electric scheme steps would be taken to protect the amenities of the area. Mr. P. Briggs, deputy controller of the North West, Merseyside and North Wales Division of the B.E.A., is reported to have said that the upper dam would be coloured to harmonize with its surroundings, the power house would be built in appropriate stone and the pipelines to the power house would be camouflaged.

Mr. Briggs said that the Authority would consider further the future of a local section of the Ffestiniog railway line which the scheme would render unusable. He pointed out, however, that the cost of providing an alternative route would be prohibitive.

Birmingham Supply Failure

The Minister of Fuel and Power has called for an immediate report on the electricity failure in Birmingham last week. Senior officials of the Midlands Electricity Board were on Friday last investigating the causes of the breakdown, which cut supplies for varying periods in the Moseley, Sparkhill, Sparkbrook and Kings Heath areas.

In an official statement the Board said that as a result of strenuous efforts by members of the staff working day and night in relays, in the worst possible weather conditions, power supplies in the Moseley district were back to normal on Friday. Twelve substations in the district were affected by the breakdown of all three of the high voltage lines carrying power to the area between Stratford Road and Kings Heath and for a short period some 6,000 consumers were without electricity. The first cable fault occurred at mid-day on Wednesday, the next at 12.30 a.m. on Thursday, and the third, causing a complete black-out, at 8.30 a.m. on Thursday. The main h.v. supply was restored by temporary connections at about 2 p.m. on Thursday, but later it was found that the load had increased so heavily that it could not all be carried and supplies were cut again to some consumers. A supply was restored in the Billesley Lane area at about 5 p.m., and to the rest of those affected—all served from College Road substation—at about 9 p.m.

Electric Cooking

Thornaby (Yorks) Town Council is considering the installation of electric cookers in council houses. Some houses, it is reported, are already wired to carry a cooker load, but others are not. Before any definite steps are taken tenants are being informed of increases in rent which will be necessary to cover the cost of the work.

Ash Disposal at Blyth

It is understood that a public inquiry may be held next month into the plan for the construction of the Blyth (Northumberland) power station. Apart from Blyth Corporation, which is objecting to the proposed system of disposing of ash from the new power station, no details of objectors to the project have been given. Whitley Bay Town Council is to obtain expert advice on the effect locally of the erection of the station. It has been suggested that ash from the station, which will be disposed of at sea, may be washed on to the beaches of the seaside resort.

Snowy Mountains Progress

Last week the Guthega Dam, the first completed portion of the Snowy Mountains (Australia) hydro-electric scheme, was handed over to the authority by the contractors. The latter, a Norwegian concern, began the work in 1951 and has completed it ahead of schedule. The dam stores water for release through a three-mile-long tunnel to the 60 MW power station at Munyang, near the eastern border of New South Wales and Victoria. The Snowy Mountains scheme as a whole is expected to develop 2,260 MW by 1976.

Yugoslavia Plan to Export Electricity

The Co-ordinating Committee of "Yugoeleksport" has adopted a scheme for the construction of four hydro-electric power stations with an output of about 6,000 million kWh per annum for the export of power to Italy, Austria and Western Germany.

INDUSTRIAL NEWS

Retail Trade Statistics

The Board of Trade is revising the monthly statistics of retail trade. The purpose is to improve the reliability of the figures compiled from retailers' monthly returns, and to make these statistics more representative of retail trade as a whole. The President of the Board of Trade has accordingly written to some 19,000 independent retailers inviting them to join the present panel of retailers who for some years have voluntarily contributed their monthly sales figures. Each trader is simply being asked to supply *one* figure each month—that of his total sales. A code number will be used in the return to ensure that the identity of individual firms is completely unknown to the staff handling the returns.

The Dounreay Reactor

During a visit to Dounreay, Caithness, Sir Christopher Hinton, managing director of the industry group of the United Kingdom Atomic Energy Authority, gave reasons for the choice of Dounreay as the site of the new reactor power station. In the first place, Sir Christopher said, in the unlikely event of a series of failures occurring and leading to atomic contamination in the adjacent district, this sparsely-populated area would be easy to deal with. Moreover it might be desired to erect further reactors and there would be sufficient land available.

At a later meeting Sir Christopher said that it was hoped to have the reactor in operation by 1959 but some of the plant would be working before that; it was intended to have some chemical plant in operation as soon as possible.

Power Tariff Claim Fails

In the Court of Session, Edinburgh, on 7th January Lord Hill Watson dismissed an action brought by the British Oxygen Co., Ltd., claiming £10,000 from the South East Scotland Electricity Board and the British Electricity Authority. The company sought this payment for alleged undue discrimination in the charges for electricity supplied at a voltage of 6,000 or more to its Hillington works during the years 1952-53-54.

The company contended that certain tariffs were illegal as being contrary to the Electricity Act, 1947, Section 37 (8), and they should be reduced.

Lord Hill Watson said that if the company had shown that the reason for differentiation between the consumers of a high voltage supply and the consumers of a low voltage supply had been illegal then the sub-section would have been contravened. Since the company's statements disclosed that the Board had legitimately differentiated between those groups of consumers, the complaint was that the differentiation was in certain respects insufficient.

In his opinion the company had not made out a relevant case that there had been undue preference shown to the users of l.v. supply and undue discrimination against the users of h.v. supply.

The argument that the company had a legal right not to be discriminated against, and that there was discrimination against it if it obtained no special agreement in circumstances where the tariff was inappropriate, was, the judge thought, fallacious because it had no legal right not to be discriminated against. The only legal right under sub-section 8 was that undue discrimination must not be exercised.

Fraud Conviction Appeal

An appeal by Peter B. Steer, of Nelson Way, Rugby, against his conviction and sentence at Rugby on 30th November on charges of fraudulently abstracting electricity and of uttering "as for a shilling" a coin of less value was upheld by the Warwickshire Quarter Sessions Appeals Committee on 3rd January. Steer had been fined £5 with the alternative of two months' imprisonment on each charge. Mr. A. E. James, for the respondents, said that when a meter inspector examined Steer's meter there should have been 191s in it, but there were only 177 shillings and 14 halfpennies which had been filed down to fit the slot. For every shilling paid for more electricity than was used, there was a rebate.

Sir Donald Finnemore, the chairman, said that to his mind fraud was something dishonest. If a man used more electricity than he intended to pay for, that was fraud, but when he had paid more than enough so that the Board had to pay him back, then fraud was hard to prove. Sir Donald said that the Committee was fully satisfied that there was no intention to defraud. On three occasions tokens were allowed. However, it was an undesirable practice, even though a person might honestly intend to pay, and there was enough money in the meter to pay the Board. The Board should make it abundantly clear that people should not use tokens.

Steer, who said that he intended to repay the money, was awarded costs for both the lower court and appeal hearings.

Ore Handling Plant Order

The General Electric Co., Ltd., announces that its Fraser & Chalmers Engineering Works, Erith, Kent, has received a contract from Colvilles, Ltd., for a 500-ton/hr ore handling plant for their stock yard at Clyde Iron Works, Glasgow. The plant, commencing from an existing travelling transporter spanning the ore stock yard, includes a 950ft long conveyor running parallel with the stock yard which will deliver the ore to another conveyor. The second conveyor will be 700ft long and will in turn deliver to an ore screening station for which all the screens, local conveyors and associated gear will also be supplied. In order that ore may be diverted to a possible future crushing plant a reversible belt feeder will be sited at the junction of the two long conveyors. The contract for this equipment includes motors and control gear.

Electrical Industries Club

At the monthly luncheon of the Electrical Industries Club held at the Connaught Rooms, London, last Tuesday, the guest speaker was Mr. Forbes Jackson, who until his recent retirement was deputy chief engineer to the London County Council. Mr. Jackson's brief talk, in which he touched upon some electrical events, general and personal, during the last fifty years, was very much appreciated by his audience.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £163 0s 0d
COPPER, H.C. Electro	ton £306 5s 0d
Fire Refined 99·70%	ton £304 0s 0d
Fire Refined 99·50%	ton £303 0s 0d
COPPER Tubes ..	lb 2s 10⅜d
Sheet	ton £359 5s 0d
H.C. wire and strip ..	ton £333 15s 0d
LEAD, English ..	ton £103 15s 0d
Foreign	ton £102 0s 0d
MERCURY	flask £110 0s 0d
TIN, block (English) ..	ton £681 10s 0d
ZINC, G.O.B. Foreign	ton £84 0s 0d
Electrolytic	ton £90 0s 0d
BRASS Tubes (solid drawn)	lb 2s 3½d
Sheet	ton £285 15s 0d
Wire	lb 2s 10⅜d
PHOSPHOR BRONZE Wire	lb 4s 3⅜d
PLATINUM	oz £30 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 28⅜d—28½d

Trolley-Buses in Ceylon

Our Colombo correspondent states that British manufacturers have offered the Mayor of Colombo long-term credit facilities for the purchase of trolley-buses to meet the city's needs. Meanwhile, the manager of the Municipal Passenger Transport

Department has outlined a scheme for the expansion of the trolley-bus service. This will mean that 43 miles of the city's roads will be traversed by trolley-buses against the present nine miles. The estimated cost of the extension, overhead construction, sub-stations and vehicles is Rs31,897,200 (£2,400,000). The manager states that the diesel buses now operating within residential areas of Colombo should be abolished as they are dangerous to the health of the residents.

Recently the Mayor announced that the Colombo Municipal Council had placed an order for ten more trolley-buses to augment the service. The maximum vehicle dimensions allowed under existing regulations are 27½ft length and 7½ft width, but the trolley-buses the Mayor wants to import are bigger. Two 78-passenger buses ordered from England will be tested on Colombo roads before they are finally approved. If adopted, it will be necessary to amend the Motor Traffic Act.

Compressor Equipment for Research

The General Electric Co., Ltd., has received a contract for a large compressor plant from the Ministry of Works. The equipment is for new Government research and testing facilities and comprises two sets of turbine and motor driven compressors with ancillary equipment. The installation will exceed 80,000 h.p. with the compressors arranged for operation in series or parallel both as compressors and exhausters.

Careers in Industry

The Federation of British Industries has just published a booklet under the title of "Public School and Grammar School Boys in Industry." It suggests that industry is in danger of neglecting the public schools and grammar schools as a source of potential managerial talent and proposes a simple scheme for providing careers advisers with information about the prospects in industry in a handy form.

Emergency Lighting Installation

One of the largest industrial emergency lighting plants ordered in recent years is now installed at the Prescot Works of British Insulated Callender's Cables, Ltd. The plant consists of two "Keepalite" equipments, built by Chloride Batteries, Ltd., which operate on the non-maintained system, i.e., the emergency circuits are normally "dead" but are automatically switched on when the mains supply fails. The larger equipment, rated to supply 16 kW at 230 V for one hour, comprises 115 Chloride sealed-in cells type DBNG.5, having a capacity of 150 Ah when discharging at the 10-hour rate, charged and controlled by apparatus mounted in a steel cubicle. The smaller equipment is rated to give 3 kW at 100 V for one hour and includes a battery of fifty DBNG.2 cells, having a capacity of 60 Ah at the 10-hour rate. In the event of a supply failure lasting more than one hour, arrangements are made for a diesel-driven alternator to be started up and take over the load.

F.B.I. and Electricity Supply

The Federation of British Industries, 21, Tothill Street, London, S.W.1, has published in booklet form (price 1s) the evidence which it submitted last year to the Herbert Committee which is inquiring into the organization and operation of the electricity supply industry. A summary of this evidence was given in our issue of 26th November last (p. 854).

Canadian Trade Fair

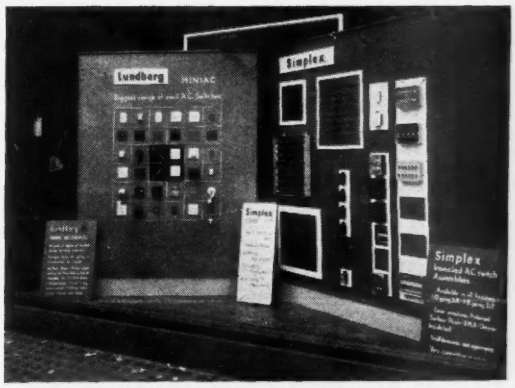
The 8th Canadian International Trade Fair, sponsored by the Canadian Government, will be held in Toronto from 30th May to 10th June next. Engineering and machine tools will form the largest sections, and a new trade section will cover welding and metals. The Exhibitions and Fairs Branch of the Board of Trade, Lacon House, Theobalds Road, London, W.C.1 (telephone: Chancery 4411, extension 436) will answer inquiries about the fair and has available descriptive literature.

Midlands Management Conference

The third Midlands Management Conference will take place at Droitwich on 4th and 5th February. It is being organized by the British Institute of Management and the Birmingham Branch of the Institute of Industrial Administration in association with the regional organizations of the Federation of British Industries and the National Union of Manufacturers. This will be the first general conference to be held in the Midlands in which firms both large and small have been invited to take part. "Management and Planning" will be the theme of the conference.

Switch Assemblies Display

The accompanying picture shows a new display recently installed in one of the windows of the London showrooms, 217-219, Tottenham Court Road, of the Simplex Electric Co., Ltd. This display incorporates a wide selection of the new Lundberg range of "Miniac" a.c. switches, and the new range of Simplex ironclad a.c. switch assemblies.



The new window display in the London showrooms of the Simplex Electric Co.

Export Finance

Nine lectures on "Recent Developments in Export Finance," arranged by the Institute of Export, are being given at the Chartered Insurance Institute, Aldermanbury, London, E.C.2, on Wednesdays, the first being given on Wednesday last. Admission is by ticket and is free to members. Single tickets will be issued to non-members at 2s per lecture, or 10s for the complete course. The address of the Institute of Export is Export House, 14, Hallam Street, London, W.1.

Control Apparatus Manufacturers

The annual luncheon of the British Industrial Measuring and Control Apparatus Manufacturers' Association (BIMCAM) will be held at Londonderry House, 19, Park Lane, London, W.1, on 18th January. The principal speakers will be Sir Edward Boyle, Parliamentary Secretary to the Ministry of Supply, and Sir Roger Duncalfe, chairman of British Glues and Chemicals, Ltd., and deputy chairman of the Beaver Committee on Air Pollution.

Power Plant for Spain

In our last issue we reported that a contract had been placed by the Instituto Nacional de Industria for plant as part of a big development scheme for Spain. The plant, which will have a total output of 142,500 kW, will be installed on the south coast, in Majorca, and in Spanish Morocco. The value of the contract approaches £2,000,000 and it has been awarded to the Metropolitan-Vickers Electrical Export Co., Ltd., in face of strong competition. Six steam turbo-generator sets are to be supplied together with condensing, feed heating and evaporating plant. Four sets are rated at 30,000 kW (two for Cadiz, one for Almeria, and one for Malaga), one at 15,000 kW (for Palma de Mallorca), and one at 7,500 kW (for Ceuta). Single-cylinder turbines will be used throughout; the 30,000-kW machines operate with inlet steam at 850 lb/sq in 900 deg F and cooling water at 80 deg F, while for the smaller turbines the figures are 600 lb/sq in 825 deg F and 68 deg F. The four larger generators (each rated at

37,500 kVA) are hydrogen-cooled and will generate at 11,800 V, the 15,000 kW and 7,500 kW machines (air-cooled) will generate at 5,200 and 15,000 V respectively.

The whole of this equipment will be manufactured at the Metropolitan-Vickers works at Trafford Park, Manchester, and Germiston, Glasgow. The first of the 30,000 kW sets and both the smaller units are planned for commissioning in the spring of 1957.

Fluorescent Lamp Efficiencies

Improvements have been made in the average light output during the first 5,000 hours of life for the 5ft and 4ft sizes of "Osram" colour matching fluorescent tubes, made by the General Electric Co., Ltd. For the 5ft 80 W tube the new figure is 2,640 lumens, an increase of 18 per cent, while the comparable figure for the 4ft 40 W tube is 1,440 lumens, corresponding to an increase of 20 per cent. The colour-rendering properties of these tubes remain unchanged.

The Edison Swan Electric Co., Ltd., announces a similar increase in the light output of Royal "Ediswan" 80 W 5ft MCF/U and MCFA/U and 40 W 4ft MCF/U and MCFA/U colour matching lamps.

Chemical Engineers' Conference

A conference on "The Functions and Education of the Chemical Engineer in Europe," arranged by the Institution of Chemical Engineers, in co-operation with the Department of Scientific and Industrial Research, will be held at Church House, Westminster, London, S.W.1, from 21st to 23rd March next. Particulars can be obtained from the general secretary of the Institution, 56, Victoria Street, London, S.W.1.

Brown Brothers Plymouth Branch

A new branch has been opened by Brown Brothers, Ltd., in Plymouth to serve traders in Devon and Cornwall. Occupying a corner site on Martin Street and Sawrey Street, the premises are capable of housing comprehensive stocks covering the motor, cycle, radio and electrical trades and comprise two floors providing floor space of approximately 20,000 sq ft. The branch manager is Mr. F. V. Matthias. The radio and electrical business of T. Brand, 55-57, Treville Street, Plymouth, which was acquired in January last year, will in future operate from the new branch under the title of Brown Brothers, Ltd.

New Plymouth branch premises of Brown Brothers, Ltd.

Power Farming

Among the papers to be read at the Power Farming Conference (Harrogate, 15th-17th February) is one by Mr. S. F. Steward, chairman of the South Western Electricity Board, on "Electricity as an Investment in the Countryside." The conference is being organized by the *Power Farmer*, Dorset House, Stamford Street, London, S.E.1.

Electrical Commercial Travellers

A ladies' evening, dinner and entertainment will be held by the Electrical Trades' Commercial Travellers' Association on 20th January at the Windsor Castle Hotel, Victoria Station, London, S.W.1 (6.30 for 7 p.m.). Tickets (11s single, 21s double) can be obtained from Mr. A. J. Murray, 46, Winstanley Road, London, S.W.11.

Power Plant for Turkey

The December *Journal* of the British Chamber of Commerce of Turkey reports that the Iller Bankasi has called for tenders by 15th February for the construction and equipment of a hydro-electric station at Bendimahi in the Turkish province of Van. The total cost, including a 124 km transmission line will be £T6·3 million (about £800,000).

Photography in Research

A lecture on "Some Photographic Techniques in Industrial Electrical Research" was recently presented by Mr. A. F. B. Young, B.Sc., A.M.I.E.E., to the Scientific and Technical Group of the Royal Photographic Society.

Mr. Young said that transient phenomena might be studied by ciné cameras of conventional type, high-speed cameras in which the film moved continuously, and ultra-high-speed cameras using some image dissection device. Particular problems might call for special camera design. He gave design and constructional details of the cameras designed to study circuit breaking equipment and the arcs formed during the operation of this equipment. The cameras were complementary in character, the first being of the rotating block compensator type operating at c.a. 1,000 frames/sec and the second a novel image dissection type operating at 10^5-10^6 frames/sec. The lecturer also discussed lighting problems involved and other photographic techniques used in this research. A model of the image dissection camera was demonstrated.

Changes of Name

Tungsram Electric Lamp Works (Great Britain), Ltd., has changed its name to the Tottenham Radio Valve Co., Ltd.

Blick Engineering, Ltd., has changed its name to Blickvac Engineering, Ltd.

C. Ryan & Co. have changed their name to Charles Ryan & Co., Ltd.

Trade Announcements

Sunvic Controls, Ltd., has appointed Mr. G. G. Harris, of "Lydstep," 20, Lawn Road, Rowley Park, Stafford (telephone: Stafford 1764), as its Midlands representative for process control. Mr. G. R. Peeke, 117, Stafford Road, Birmingham, 11 (telephone: Birmingham, Victoria 1076), will continue to look after the company's interests in the Midlands for scientific and industrial instruments.

Hoover, Ltd., has moved its Canterbury, Kent, district office to 11-13, St. George's Street.

The only address of **Straight-Lite Reflectors, Ltd.,** is now 36, Eden Grove, Holloway, London, N.7 (telephone: North 4296/7).

The Bournemouth branch office of the **Hotpoint Electric Appliance Co., Ltd.,** is now at 63, Holdenhurst Road, Bournemouth (telephone: Bournemouth 3593).

The **Northern Aluminium Co., Ltd.,** has moved its Birmingham area sales office to new and larger offices at 14, Bennetts Hill, Birmingham, 2. The telephone number and telegraphic address are unchanged.

CATALOGUES AND LISTS

ACCESSORIES.—32-page priced catalogue covering the range of "Wylex" plugs, sockets, switches, etc. (W910).—**George H. Scholes & Co., Ltd.,** Wylex Works, Wythenshawe, Manchester.

Illustrated catalogue of "Otto Meinzer" joints for electrical fittings, including universal joints, joints for wing nuts, standard lamps, bridge lamps, etc.—**Walter Logan & Co., Ltd.,** 34, Oak Tree Drive, London, N.20.

HEATING EQUIPMENT. — Illustrated priced leaflet on the "Warm-Glow" pipe heater.—**Warm-Glow Co., Ltd.,** Progress Road, Leigh-on-Sea, Essex.

ORE MILLS.—20-page illustrated catalogue dealing with Hardinge conical mills for ore reduction.—**International Combustion Products, Ltd.,** 19, Woburn Place, London, W.C.1.

SWITCHGEAR.—Leaflet giving details of the company's range of h.v. outdoor isolating switches up to 275 kV.—**Line Equipment, Ltd.,** 32, Queen Victoria Street, London, E.C.4.

TOOLS.—Illustrated booklet on solderless wiring connections, including details of hand-crimping tools, connectors and crimping accessories (753).—**Plessey Co., Ltd.,** Ilford, Essex.

TRANSFORMERS.—Illustrated technical catalogue of "Green Seal" dry type transformers and a leaflet on the "Brentford" automatic tail-end booster.—**Brentford Transformers, Ltd.,** Kidbrooke Park Road, London, S.E.3.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 231, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 17th January

BIRMINGHAM.—Grand Hotel, Colmore Row, 6.15 p.m. Birmingham Electric Club. "Earthing and Earth Leakage Protection," by H. W. Swann.

BRISTOL. — Electricity House, Colston Avenue, 6 p.m. I.E.E. Western Centre. "A Transatlantic Telephone Cable," by Sir Gordon Radley. (Joint meeting with the Institution of Post Office Electrical Engineers.)

IPSWICH. — Electric House, 7.30 p.m. Ipswich & District Electrical Association. President's Address by C. T. Melling.

LONDON.—Savoy Place, W.C.2, 6.30 p.m. I.E.E. London Students' Section. Film evening.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. "Determination of the Static and Dynamic Elastic Properties of Resilient Materials," by R. S. Jackson, Dr. A. J. King and C. R. Maguire.

READING.—George Hotel, 7.15 p.m. I.E.E. district meeting. "Post Office and Power Overhead Lines—New Methods of Guarding," by S. J. Little and H. Fielding.

Tuesday, 18th January

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. "Some Design Features of the Semi-Outdoor Power Station at Ince," by F. H. S. Brown.

GLASGOW.—Burlington House. Institution of Heating and Ventilating Engineers, Scottish Branch. Annual dinner and dance.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilization Group. "Safety in the Use of Portable and Transportable Electrical Equipment in Industry," by J. Bunting.

LIVERPOOL.—9, The Temple, 24, Dale Street, 6.30 p.m. I.E.S. Liverpool Centre. "The Application of Light in Medicine," by Dr. J. G. Fox.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Measurements Section. Discussion on "The Human Operator in Closed Loop Control Systems," opened by Prof. C. Holt Smith.

Londonderry House, Park Lane, W.1. British Industrial Measuring & Control Apparatus Manufacturers' Association. Annual luncheon.

MANCHESTER.—Free Trade Hall, 7.30 p.m. I.E.E. North-Western Centre. Faraday Lecture: "Courier to Carrier in Communications," by T. B. D. Terroni.

Tuesday, 18th January, to Friday, 28th January

LONDON.—Olympia. International Packaging Exhibition.

Wednesday, 19th January

BRISTOL.—Grand Hotel, 7.15 p.m. Incorporated Plant Engineers, Western Branch. "Space Heating and the Plant Engineer," by T. H. F. Holman.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. "Some Design Features of the Semi-Outdoor Power Station at Ince," by F. H. S. Brown.

LEEDS.—Mansion Hotel, Roundhay. Institution of Heating and Ventilating Engineers, Yorkshire Branch. Annual dinner-dance.

LEICESTER.—Technical College, 7 p.m. I.E.E. East Midland Students' Section. "Modern Electrical Methods of Balancing Machines," by E. P. Fowler.

LONDON.—Savoy Place, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Education and Training for Engineers and Craftsmen in France," opened by R. G. Bellamy.

Café Royal. I.E.E. Utilization Section. Dinner-dance.

At the Institution of Mechanical Engineers, Birdcage Walk, 6 p.m. Institution of Heating and Ventilating Engineers. "Engineering Services in a Laboratory," by J. C. Knight.

MIDDLESBROUGH. — At the Cleveland Scientific & Technical Institute, Corporation Road, 6.30 p.m. I.E.S. Tees-Side Group. "The Application and Maintenance of Discharge Lamp Installations," by J. J. French.

NORWICH.—Assembly House, 7.30 p.m. I.E.E. district meeting. "The Electrification of the Manchester-Sheffield-Wath Lines, Eastern and London Midland Regions, British Railways," by J. A. Broughall and K. J. Cook.

PRESTON.—N.W.E.B., 19, Friargate, 7.15 p.m. I.E.S. North Lancashire Group. "Lighting for Enjoyment," by T. O. Freeth.

ROCHESTER.—Bull Hotel, 7 p.m. Incorporated Plant Engineers, Kent Branch. "Industrial Space Heating," by J. Evans.

Thursday, 20th January

BLACKBURN.—Golden Lion Hotel, 7.30 p.m. Incorporated Plant Engineers, Blackburn Branch. "An Introduction to Atomic Energy," by J. A. Dixon.

CARDIFF.—Park Hotel. South Wales Institute of Engineers. Annual dinner.

CHELMSFORD. — Crompton Parkinson's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "Submerged Telephone Repeaters for Shallow Waters," by R. J. Halsey.

EDINBURGH. — The University, 7 p.m. British Institution of Radio Engineers, Scottish Section. "Modern Ship-to-Shore Communication," by G. Macdonald.

LEICESTER. — College of Commerce & Technology, 7.15 p.m. Institute of Welding East Midlands Branch. "Automatic Arc Welding," by A. Bean and E. T. J. Harbron.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Utilization Section. "Design, Performance and Application of Miniature Circuit-Breakers," by H. W. Wolff and T. G. F. Atherton.

At the Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. The Institute of Fuel. Discussion on "The Beaver Report," opened by Dr. G. E. Foxwell.

MANCHESTER.—N.W.E.B., Town Hall, 6 p.m. I.E.S. Manchester Centre. "Lighting for Decoration," by P. Corry and A. E. Hurst. (Joint meeting with the E.A.W.)

TAUNTON.—Electricity Showrooms, 7 p.m. I.E.E. Bristol Students' Section. "Electricity in the Modern Aeroplane," by E. T. Barry.

Friday, 21st January

COVENTRY.—G.E.C. Ballroom, Copsewood. Coventry Electric Club. Annual dinner-dance.

FARNBOROUGH.—R.A.E. Technical College, 6.30 p.m. I.E.E. Southern Centre. "The Possibilities of a Cross-Channel Power Link between the British and French Supply Systems," by D. P. Sayers, M. E. Laborde and F. J. Lane.

LEEDS. — Incorporated Plant Engineers, West & East Yorks Branch. Annual dinner and dance.

LONDON.—Caxton Hall, 6.30 p.m. E.P.E.A. Southern Meter Engineers' Group. "Grid Control Telemetering and Instrumentation," by P. F. Gunning.

INDIAN ELECTRICAL IMPORTS

INDIA'S imports of electrical goods in the financial year ended March, 1954, totalled Rs. 319,171,000 in value, an increase of Rs. 9,544,000 on the previous twelve months. (These figures do not include radio apparatus which is classified elsewhere in the official returns.) The increase was by no means spread over all categories. The total of apparatus and appliances showed approximately a decrease of Rs. 7,700,000 and that of machinery an advance of Rs. 17,000,000. The United Kingdom retained about two-thirds of the aggregate trade, better business in machinery having offset a decline in many of the smaller lines. Values of the principal items are shown in the accompanying table with notes of increases and decreases.

Class of Equipment	1953-54 Thou. Rs	Inc.or dec. on 1952-53 Thou. Rs
Fans and parts	683	+ 137
Wires and cables, not telegraph of telephone, rubber insulated	9,712*	+ 1,908
Ditto, other insulation	47,730	− 13,031
From U.K.	41,762	− 14,161
,, *U.S.A.*	1,139	+ 775
Telegraph and telephone instruments and apparatus	4,884	+ 1,033
From U.K.	3,417	+ 516
Telegraph and telephone wires and cables	9,628	+ 8,611
Electric lamps	358	− 31
Vacuum electric lamps	75	− 85
Electric lamps for automobiles	13	− 1,968
From U.K.	2	− 247
,, *U.S.A.*	9	− 1,256
Electric bulbs for torches	1,801	− 98
From Hong Kong	521	− 132
,, *U.S.A.*	9	− 196
,, *Netherlands*	1,205	+ 275
Other electric lamps	2,809	− 72
From U.K.	650	− 552
,, *Netherlands*	1,027	+ 255
,, *U.S.A.*	253	− 248
Radio apparatus	11,843	− 3,148
From U.K.	6,967	− 2,116
,, *U.S.A.*	1,196	− 691
Batteries	1,531	− 153
From U.K.	673	− 524
,, *U.S.A.*	689	+ 342
Accumulators and parts	1,280	− 1,681
From U.K.	801	− 1,909
Electric condensers	527	− 30
Electric bell apparatus	315	+ 173
Electric lighting accessories and fittings, including switches	4,973	− 24
From U.K.	3,133	− 722
Meters	6,283	− 432
From U.K.	3,432	− 386
,, *Switzerland*	986	− 30
Other electrical instruments	1,169	− 911
From U.K.	966	− 718
Electro-medical apparatus	3,343	+ 471
From U.K.	552	− 203
,, *U.S.A.*	1,443	+ 460
Switchboards other than telegraph or telephone	1,065*	+ 539
Electrical porcelain ware	908	+ 465
Electrical goods and apparatus not enumerated	16,933	− 5,372
From U.K.	10,032	− 3,316
,, *U.S.A.*	3,328	+ 548
,, *Canada*	189	− 259
Control and switchgear	56,974	+ 2,138
Generators, alternators and dynamos	40,837	+ 16,207
Motors	14,370	+ 2,080
Transformers	19,424	+ 4,999
Turbo-generator sets	7,652	− 5,332
Other electrical machinery	49,517	− 2,803

* Mainly from U.K.

Domestic Electrical Equipment

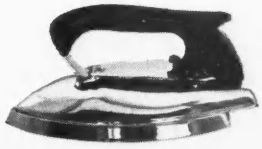
Electric Irons

MOST electric irons are now thermostatically controlled and in general there is a tendency for all types to be made somewhat lighter. The average weight is 4 to 5 lb, but some of the latest lightweight models weigh little more than 2 lb. The latter type employ almost indestructible elements embedded in the sole plate and this method of construction is claimed to add considerably to the life of the iron. As a means of reducing failure due to flex wear and breakage, the flex in most cases is permanently connected to the iron. Iron stands are also available both for use during actual ironing and stowage purposes. A step further is to dispense with the flex altogether, as is the case with " no-flex " irons which are designed for plugging into the electricity supply between ironing operations. Steam-or-dry irons are also growing in popularity and three manufacturers now produce them. An advantage is that when not required for steaming purposes these irons can also be used in the normal way ; it is thus unnecessary to have both types. Small travelling irons are also produced weighing from 1¼ to 3 lb.

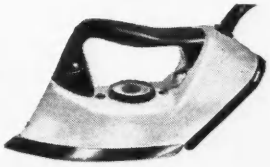
Manufacturer	Name or Model	Type	Weight	Loading	Special Features	Finish	Price
A.B. METAL PRODUCTS, LTD., Ynysboeth, Abercynon, Glam.	" Clem "	Travelling	1½ lb	80 W	Universal voltage	Anodized body, chromium sole plate	£1 15 0
BYLOCK ELECTRIC, LTD., South Street, Ponders End, Middlesex.	" Victor "	Automatic, tilting safety	5 lb	750 W	Left or right handed	Pastel, primrose, blue or green	£3 2 6
CO-OPERATIVE WHOLESALE SOCIETY, LTD., National Works, Hall Street, Dudley.	" Senior "	Automatic	4½ lb	800 W	—	Chromium	£2 5 0
	" Major "	Non-Automatic	5½ lb	550 W	—	Chromium	£1 13 6
	" Minor "	Non-Automatic	4½ lb	450 W	—	Chromium	£1 2 0
" DONALDSON " WIRELESS ELECTRIC IRONS, LTD., 31, Sloan Street, Leith, Edinburgh, 6.	" Donaldson "	Cordless	5 & 6 lb	600 W	Complete with heating unit	—	£5 7 6
EASIPOWER, LTD., 213/215, Gloucester Place, London, N.W.1.	" 100/D "	Automatic	5 lb	600 W	Pilot light	Chromium or vitreous enamel	£2 5 0
	" 99 "	Automatic	3½ lb	600 W	Pilot light	Vitreous enamel (4 colours)	£2 2 6
	" 99U "	Automatic	3¼ lb	600 W	Pilot light a.c./d.c.	Vitreous enamel (4 colours)	£2 5 0
ELGA PRODUCTS, LTD., Railway Place, Wimbledon, S.W.19.	" Gadabout "	Travelling	1½ lb	300 W	Fold-flat handle, travel pouch	Chromium	£1 19 6 £2 2 0 (with pouch)
FALK, STADELMANN & CO., LTD., 91, Farringdon Road, London, E.C.1.	" Featherlight " 95659	Automatic	3 lb	750 W	Left or right handed, button contour	Chromium	£1 19 6
	" Pilot " 95707	Automatic	4½ lb	750 W	Left or right handed, pilot light	Chromium	£2 2 6
	" Standard " 95669	Non-Automatic	4½ lb	450 W	Left or right handed	Chromium	£1 8 6
	" Gadabout " 95636	Travelling	1½ lb	300 W	Folds into suedette pouch	Chromium	£1 19 6 (pouch extra)
W. T. FRENCH & SON, LTD., Mysto Works, Browning Street, Birmingham, 16.	" Thermo " 994	Automatic	5½ lb	650 W	Left or right handed, pilot light	Cream stoved enamel	£2 10 0
	" Popular " 992	Non-Automatic	4½ lb	450 W	Left or right handed	Nickel plated	£1 6 6
	" Standard " 997	Non-Automatic	3½ lb	450 W	Right handed only	Chromium	£1 1 0
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, WC.2.	" D5805 "	Non-Automatic	5 lb	450 W	—	Chromium	£1 12 6
	" D5827 "	Travelling	3 lb	300 W	Fold-flat handle, universal voltage	Chromium	£2 15 0
	" D5850 " " Bride's " Iron	Automatic	2¼ lb	750 W	Lightweight	Chromium	£2 2 6
	" D5850 " " Bride's " Iron	Automatic	3¼ lb	750 W	Lightweight	Cream vitreous enamel	£2 5 0
GRAFTON HEATER CO., LTD., 13-15, Westland Place, London, N.1.	" DD1 "	Automatic	5 lb	750 W	Left or right handed	Blue, green or primrose stoved enamel	£1 17 6 £2 2 6 (chromium)

Manufacturer	Name or Model	Type	Weight	Loading	Special Features	Finish	Price
L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, London, W.C.2.	"L.G.H.1220"	Automatic	4¼ lb	800 W	Dial controls include on/off switch	Chromium	£2 9 6
H.M.V. HOUSEHOLD APPLIANCES, Hayes, Middlesex.	"Milady's Iron"	Automatic	4 lb	750 W	Left or right handed, pilot light	Primrose vitreous enamel	£1 19 6 £2 2 6 (a.c./d.c.)
HOMEFYRE, LTD., 66-72, Brewery Road, London, N.7.	"160T"	Automatic	4½ lb	650 W	Left or right handed	Chromium, nickel or coloured	On application
	"160A"	Non-Automatic	4½ lb	450 W	Left or right handed	Chromium, nickel or coloured	On application
	"M1000"	Non-Automatic	3 lb	450 W	Lightweight connectorless	Chromium, nickel or coloured	On application
HOOVER, LTD., Perivale, Greenford, Middx.	"Steam-or-Dry"	Automatic	3½ lb (dry) 4 lb (filled)	1 kW	Left or right handed	Chromium	£4 19 6
HOTPOINT ELECTRIC APPLIANCE CO., LTD., Crown House, Aldwych, W.C.2.	"Plus-Five"	Automatic	6 lb	800 W	Swivelling flex, left or right handed, button contours	Chromium	£3 15 0
	"Rightweight"	Automatic	3¾ lb	1 kW	Swivelling flex, left or right handed, button contours	Chromium	£3 5 0
JELSON ELECTRIC, LTD., Spring Road, Tyseley, Birmingham, 11.	"MX20"	Automatic	4½ lb	800 W	—	Chromium	£2 5 0
ARCHIBALD KENRICK & SONS, LTD., Kenrick House, Newman Street, London, W.1.	"Kensun"	Non-Automatic	—	450 W	Lightweight	Nickel plated or primrose	£1 0 6

A.B. Metal Products "Clem" travelling iron



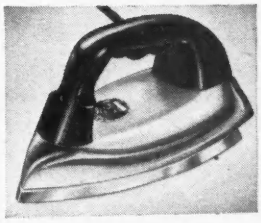
L. G. Hawkins "L.G.H.1220" automatic



Bylock "Victor" safety iron

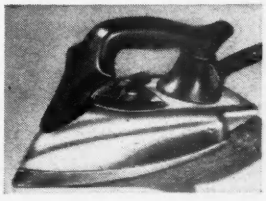
Hoover "Steam-or-Dry"

"Easipower" automatic

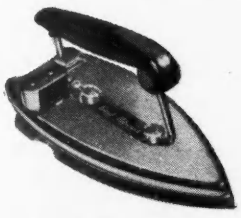


Homefyre "160T" heat controlled

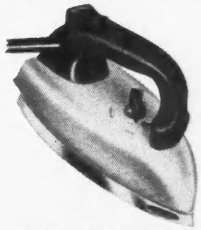
H.M.V. "Milady's" iron



Hotpoint "Plus Five"



Elga "Gadabout" travel iron



Falk's "Featherlight" 95659

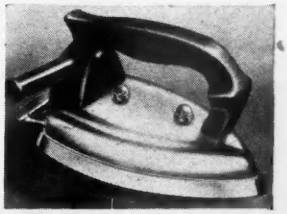
C.W.S. "Senior" automatic

G.E.C. "Bride's" iron

Jelson "MX20" automatic

"Grafton" heat controlled

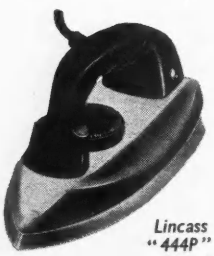
Archibald Kenrick "Kensun"



W. T. French "992" non-automatic

ELECTRIC IRONS . . . . . *continued*

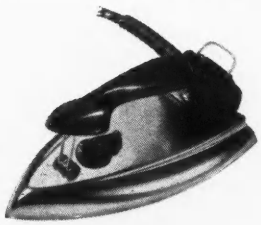
Manufacturer	Name or Model	Type	Weight	Loading	Special Features	Finish	Price
KENWOOD ELECTRICS, LTD., 26, North Audley Street, London, W.1.	"Steam-o-matic"	Steam or dry	3½ lb	1 kW	Stainless steel throughout	Polished stainless steel	£4 19 6
LINCASS ELECTRIC, LTD., White Hart Yard, Guildford Street, Chertsey, Surrey.	"444P" and "446P"	Automatic	4½ lb	750 W	Pancake selector dial, left and right handed, pilot light	Chromium	£1 19 6 (a.c.) £2 2 6 (d.c.)
	"434P" and "436P"	Automatic	4½ lb	750 W	Pancake selector dial, left and right handed, pilot light	Coloured enamel	£1 18 6 (a.c.) £2 1 6 (d.c.)
	"444PH" and "434PH"	Automatic	6 lb	750 W (a.c. only)	Pancake selector dial, left and right handed, pilot light	Chromium and coloured enamel	£2 2 0 (chromium) £2 1 0 (coloured)
	"144" and "134"	Non-Automatic	4½ lb	450 W (a.c./d.c.)	Left and right handed	Chromium and coloured enamel	£1 5 0 (chromium) £1 4 0 (coloured)
LUCAS HOLDER, LTD., 25, Allesley Old Road, Coventry.	"Smoothie"	Travelling	1¼ lb	75 W	Zip leather cases available	Chromium	£1 8 0 (standard) £1 12 6 (universal)
METWAY ELECTRICAL INDUSTRIES, LTD., Canning Street, Kemp Town, Brighton, 7.	"DA439"	Automatic	4½ lb	700 W	Pilot light, chromium sole plate	Green, cream or blue	£2 3 9
	"DA224"	Non-Automatic	5 lb	450 W	Nickel plated sole plate	Coloured or nickel plated	£1 2 4
	"DA186"	Travelling	2 lb	150 W	Nickel plated sole plate	Coloured or nickel plated	£0 18 6
MORPHY-RICHARDS, LTD., 6, Conduit Street, London, W.1.	"Senior"	Automatic midweight	4½ lb	750 W	Pilot light, thermostatic control	Coloured metal or porcelain or chromium	From £1 19 6
	"Atlantic"	Automatic lightweight	2¾ lb	750 W	Pilot light, thermostatic control, reversible flex	Coloured metal or chromium	From £1 19 6
	"Auto-Control Travel"	Travelling	1¾ lb	375 W	Fitted with universal 2-pin plug, fold-flat handle	Chromium	From £2 5 0
	"Steam and Dry"	Automatic	3 lb (dry) 3¼ lb (filled)	750 W	Pilot light, reversible flex	Chromium	From £2 19 6
PREMIER ELECTRIC HEATERS, LTD., Keeley Street, Birmingham, 9.	"Super-Smoothwell" 835	Automatic	5 lb	750 W	Pilot light	Chromium	£2 5 0
	"Nine-O-Nine" 909	Automatic	5 lb	1 kW and 800 W	Pilot light, left and right handed	Chromium	£4 2 6
	"Sylph" 861	Automatic	3¼ lb	1 kW and 800 W	Pilot light, element cast into base	Chromium	£2 19 6
	"Smoothwell" 814	Non-Automatic	4¾ lb	450 W	Modern design	Chromium	£1 8 0
REVO ELECTRIC CO., LTD., Tipton, Staffs.	"Automatic"	Automatic	4¼ lb	650 W	Left and right handed, pilot light	Chromium	£2 5 0



Lincass "444P" automatic

Lincass non-automatic

Morphy-Richards steam iron

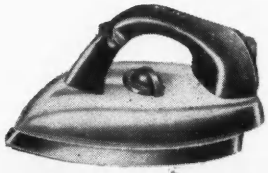


Morphy-Richards travel iron

Kenwood "Steam-o-matic"

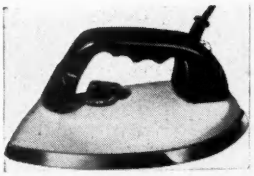
Lucas Holder "Smoothie"

Metway travel iron



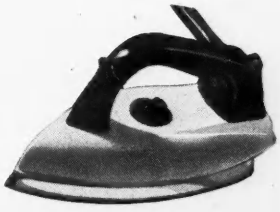
Metway automatic

Manufacturer	Name or Model	Type	Weight	Loading	Special Features	Finish	Price
ROBSON ELECTRICAL PRODUCTS, LTD., Ultralite Works, Union Street, West Bromwich.	"Explorer"	Non-Automatic	5 lb	450 W	—	Coloured or nickel plated	£0 19 6
	"Ultralite"	Non-Automatic	5 lb	450 W	—	Chromium	£1 3 0
	"Roblec"	Automatic	4½ lb	700 W	—	Coloured or nickel plated	£1 13 9 (coloured) £1 14 6 (nickel)
	"Roblec"	Automatic	4½ lb	700 W	Pilot light	Coloured or chromium	£1 17 6 (coloured) £1 19 6 (chromium)
	"Roblec Junior"	Travelling	2 lb	200 W	—	Coloured or nickel plated	£0 15 6
TELSEN ELECTRIC CO. (1935), LTD., Fitzgeorge Street, Rochdale Road, Manchester, 9.	"1141"	Non-Automatic	6 lb	450 W	—	Nickel plated	£1 6 0
	"1142 Jubilee"	Non-Automatic	5½ lb	450 W	—	Nickel plated	£1 0 0
	"1146 Victory"	Non-Automatic	6 lb	450 W	Moulded heel rest	Nickel plated	£1 7 6
	"1144 Royal"	Automatic	5¾ lb	600 W	—	Nickel plated	£2 2 6
	"1145"	Automatic	5½ lb	600 W	Double ended	Nickel plated	£2 5 0
	"1149 Victory"	Automatic	—	600 W	Moulded heel rest	Nickel plated	£1 15 0
	"1147" and "1148"	Travelling	—	175 W	Wooden (1147) or moulded (1148) handles	Anodized aluminium	£0 12 0 (1147) £0 14 6 (1148)
THORN ELECTRICAL INDUSTRIES, LTD., 105-109, Judd Street, London, W.C.1.	"Mary Ann Doubleway"	Automatic	5 lb	500/750 W	Double ended, lightweight stand	Cream enamel	£2 2 0 (a.c.) £2 5 0 (d.c.)
TYM'S ELECTRIC, Systym Works, Kennard Road, Stratford, E.15.	Systym "Golden Arrow"	Automatic	5½ lb	750 W	Pilot light	Coloured stoved enamel or chromium	£1 19 6 (coloured) £2 2 0 (chromium)
	Systym "Streamlined Safety"	Non-Automatic	4 lb	450 W	—	Chromium	£0 18 11
J. & H. WALTER, LTD., Domestic Appliance Division, Farm Lane, Fulham, S.W.6.	"Walter No-Cord" 3000	Automatic	5 lb	900 W	Cordless and complete with ironing table	Iron chromium, table primrose enamel	£12 12 0
	"Walter No-Cord" 3001	Automatic	7 lb	1,200 W	Cordless and complete with ironing table	Iron chromium, table primrose enamel	£13 2 0

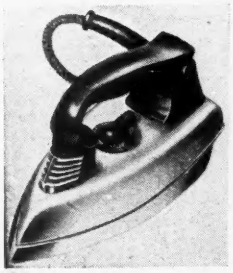


Thorn "Mary Ann"

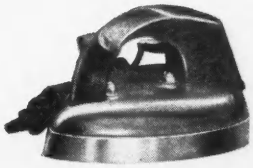
Revo "Automatic"



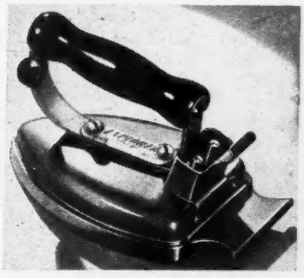
Robson "Roblec"



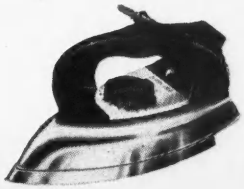
Premier "909"



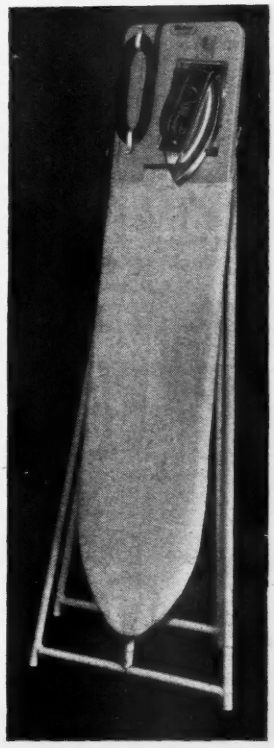
Telsen "1148" travelling type



Robson "Explorer" (non-automatic)



Premier "Super Smoothwell"



Walter "No-Cord" iron and ironing board

Financial Section

STOCKS and SHARES

AS was to be expected, most of the Stock Exchange markets became substantially better after the avoidance of the railway stoppage, although the initial response was perhaps more restrained than it might have been in the absence of a severe disturbance in American stock markets at about the same time. Like our own, the transatlantic stock-price indices have until lately been breaking all previous records. A moderate tightening-up of American regulations affecting speculation seemed to touch off a reactionary movement violent enough to evoke dim shades of the 1929 crash. Few people seem inclined, however, to read this as more than a passing phase; by the beginning of this week the tone on both sides of the Atlantic was confident.

Price Changes

British Electricity stocks mostly recovered half a point of previous declines, but talk of dearer money continued to unsettle the gilt-edged market. In the electrical equipment market, the rise in Telegraph Constructions continued to 38s 9d, a gain of 1s 3d on top of earlier advances. Reyrolles were strong, putting on 6s 3d. A.E.I. gained 3s 9d and improvements of 1s or more were recorded in I.C.I., Electrical Components and London Electric Wire. Babcocks and International Combustion were good. British Vacuum Cleaners rose 1s 6d; Hoovers and Falk Stadelmanns were also in favour.

Radio Shares

A resumption of aggressive buying of Decca 4s ordinary, in advance of the cash issue of new shares, has been the feature of a generally active market in radio securities. Before the posting of the allotment letters the price raced up to 67s, which compared with the figure of 50s ruling immediately before the announcement of the annual results a month ago. These included an increase in the dividend from 1s 9d to 2s 3d per share, and proposals for a free scrip issue as well as the "rights" offer. The shares were quoted in their ex-rights form on Wednesday in this week. Plessey 5s shares have also been outstanding; at 70s 6d they showed a rise of 11s in the course of only a month.

General Cable

Last month the General Cable Manufacturing Company agreed to buy from Radio & Televison Trust the majority of the shares in the Britannic Electric Cable Co. the consideration for 531,800 shares of 5s being about £425,000. It was explained, at the recent annual meeting of General Cables that the deal furthered a policy of extending the interests to cover as much as possible of the wide range of cable products demanded by electrical developments at home and abroad. Most of the Britannic Com-

Week's Price Changes

Company or Board	Nom. Value	Middle price 10th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1954 Highest	1954 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	95		3	3	3 3 2	97	88⅞
Brit. Elec. 1974/77	100	94	+½	3	3	3 3 10	96½	87½
Brit. Elec. 1976/79	100	99	+½	3½	3½	3 10 8	101½	93 5/16
Brit. Elec. 1974/79	100	109	+½	4¼	4¼	3 18 0	111½	103 3/16
Overseas Electric Supply								
Calcutta Elec.	£1	22/-		6†	6†	5 9 0†	24/6	18/7
East African Power	£1	23/-		7	7	6 1 9	23/4	19/6
Nigerian Elec.	£1	22/6		10	10	8 17 10	25/-	23/6
Palestine Elec. "A"	£1	22/-	+1/-	Nil	Nil	—	21/-	16/-
Perak Hydro-Elec.	£1	20/-		6	10	10 0 0	20/-	13/9
Equipment and Manufacturing								
Aberdare Cables	5/-	13/6	−3d	25	12½*	4 12 7	14/3	8/1
Aerialite	1/-	12/-	+3d	88⅓	88⅓	7 7 2	14/6	10/9
Allen, W. H.	£1	78/3		15	20	5 2 3	78/6	50/-
Aron Elec. Ord.	£1	56/6		20	15	5 6 4	60/-	43/-
Assoc. Elec. Ord.	£1	66/3	+3/9	20	11¼*	3 7 6	62/6	41/6
Automatic Tel. & El.	£1	71/3	+6d	15	15	—	73/-	57/3
Babcock & Wilcox	£1	72/6	+3/6	18	12*	3 6 3	76/3	47/3
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/6	3/9
Bakelite	10/-	28/3		12½	12½	4 8 6	32/-	23/6
British Aluminium	£1	41/3	+6d	12	10	4 17 0	41/-	33/9
B.I. Callender's	£1	48/6		10	10	4 2 6	52/-	37/9
B.I. Callender's 6% Pref. ...	£1	26/3		6	6	4 11 6	26/6	24/3
British Thermostat	5/-	26/3		35	27½*	—	28/-	12/-
British Vac. Cleaner	5/-	15/9	+1/6	15	25	7 18 9	14/6	11/6
Brook Motors	10/-	42/6		20	20*	—	45/6	29/3
Brush Ord.	5/-	7/9	+3d	4	6	3 17 6	8/3	3/6
Bulgin, A. F.	1/-	4/3		30	30	7 1 3	4/3	3/2
Burco	5/-	21/-		35	25*	5 19 0	21/6	12/1
Chloride El. Storage "A" ...	£1	66/-		20	12½*	3 16 3	68/6	46/6
Clarke Chapman	£1	72/6	+2/6	17½	20	—	73/-	47/6
Cole, E. K.	5/-	20/-		25	27½	—	20/-	11/6
Cossor, A. C.	5/-	9/6		10	10	5 5 3	11/-	7/-
Crabtree	10/-	30/-	−6d	17½	20	6 13 4	32/-	23/9
Crompton Parkinson Ord. ...	5/-	16/9		20	20	—	17/9	11/6
De La Rue	5/-	22/6	−1/3	Nil	20	4 9 0	24/-	12/3
Decca	4/-	63/6xr	+7/-	35	56¼*	—	56/6	32/-
Desoutter	5/-	26/3		18	20	3 16 4	26/6	16/1
Dewhurst	2/-	7/6		19	24	6 8 0	7/6	5/1
Dictograph Tel.	2/-	7/3		20	20	5 10 4	8/-	5/2
Dubilier Condenser	1/-	4/9	+3d	25	25	—	5/3	3/3
E.M.I.	10/-	26/6		8	10	3 15 6	27/9	11/3
Electrical Components	5/-	17/3	+1/-	20	20	5 16 0	16/3	10/9
Elec. Construction	£1	35/-		15	15	4 5 9*	35/-	26/6
Enfield Cable Ord.	£1	22/6		5	Nil	Nil	26/3	16/6
English Electric	£1	55/-		15	10*	3 12 9	59/-	38/-
English Electric 3¾% Pref. ...	£1	16/9		3¾	3¾	4 9 7	16/9	15/3
Ericsson Tel.	5/-	32/9		22†	25†	—	33/9	22/9
Ever Ready	5/-	23/6		35	40	—	26/3	17/9
Falk Stadelmann	£1	48/6	+6d	15	15	6 3 9	49/-	36/6
G.E.C. Ord.	£1	58/9		11¼	12½	4 5 0	60/-	37/6
G.E.C. 6½% Pref.	£1	28/9		6½	6½	4 10 6	28/9	26/6
General Cables	5/-	16/9	−3d	30	30	8 19 0	18/-	16/3
Greenwood & Batley	£1	55/-		17½	17½	6 7 3	55/-	40/3
Hackbridge Cable	5/-	15/6	+3d	20	20	6 9 0	15/9	11/3
Hackbridge & Hewittic	5/-	24/6	−6d	20	25	5 2 0	25/-	16/10
Hall Tel. Acc.	10/-	11/6	−6d	10	10	8 14 0	13/-	10/6
Heatrae	2/-	5/3		12½	12½	4 11 0	5/6	4/-
Henley's	10/-	18/3	+3d	10½	10½	5 15 0	22/-	15/6
Holophane...	5/-	17/3		20	25	7 5 0	18/-	13/1

* After capital bonus. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

pany's production consists of paper-insulated power cables. Some 30 per cent of the latest acquisiton of shares is being taken up by F. McNeill & Co., which controls the ordinary capital of General Cables. The latter will find the balance of £300,000 largely by means of temporary borrowing.

Earnings of General Cable Manufacturing for the year ended last September represented a little over 40 per cent gross on the £150,000 ordinary capital. They were affected, it was disclosed at the meeting, by continued cable stock reductions and copper price uncertainties, as well as by the delay in the appearance of the Monopolies report. Sales were maintained, however, and conditions were said by the chairman to have improved since the end of the financial year.

in Electrical Investments

Company or Board	Nom. Value	Middle price 10th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1954 Highest	1954 Lowest
Equipment and Manufacturing—continued.								
Hoover	5/-	45/9	+6d	25	45	4 18 3	51/-	26/3
I.C.I.	£1	43/3	+1/6	13	15	3 9 3*	43/6	26/6
Intl. Combustion	5/-	28/-	+1/3	15	20	3 11 6	30/-	14/6
Johnson & Phillips	£1	45/6		15	15	6 11 9	52/6	45/6
Lancashire Dynamo	£1	55/9	+9d	12½	14	5 0 6	59/6	43/-
Laurence, Scott	5/-	14/9		15	20	3 7 9*	14/9	7/-
Lister, R. A.	£1	31/-		9	12	—	33/-	22/6
London Elec. Wire	£1	52/6	+1/6	15	10*	3 16 4	54/-	38/-
Lucas, J.	£1	44/6		10·8	7½*	3 7 6	49/-	25/3
Marryat & Scott	2/-	9/6		22½	25	5 5 3	9/6	5/11
Mather & Platt	£1	51/6	+3/6	12½	15	—	53/-	32/-
Metal Industries	£1	32/-	−6d	12	9	5 12 6	42/3	29/6
Midland Elec. Mfg.	£1	43/9		15	15	—	43/9	31/6
Morphy-Richards	4/-	29/6	+3/-	40	35*	4 15 0	27/6	11/4
Murex	£1	51/6xd		15	15	5 16 6	57/-	49/-
Newman Ind.	2/-	2/4½		10	10	8 8 5	2/6	2/-
Oldham & Son	1/-	3/3		17½	17½	5 7 9	3/4	2/5
Parnall (Yate)	5/-	11/4½	+1/-	6	8	3 8 3	11/-	4/3
Parsons, C. A.	£1	57/6		12½*	7½*	2 12 3	60/-	38/1
Plessey	10/-	70/6	+4/3	30	20*	2 15 6	64/-	37/10
Pye Deferred	5/-	35/6		20	20*	2 16 3	37/-	15/7
Revo	10/-	15/-		27½	9*	6 0 0	20/3	14/-
Reyrolle	£1	95/-	+6/3	12½	13¾	2 18 9	92/6	66/-
Rheostatic	4/-	15/3		19	20	5 5 0	15/9	11/-
Richardsons Westgarth	5/-	11/3		15	15*	6 13 4	12/3	6/6
Scottish Cables	4/-	19/6	+3d	20	27½	5 12 9	21/9	12/1
Siemens Ord.	£1	45/6	+2/6	10	10	4 8 0	44/-	33/9
Smith (England), S.	4/-	17/6		15	17½*	4 0 0	17/6	7/8
Southern Areas	£1	31/3		6	7½	4 16 0	32/6	17/6
Strand Elec.	5/-	9/3		17½	17½	9 9 3	10/3	8/3
Sturtevant	5/-	21/6		18·1†	18·9*†	—	22/9	14/6
Sun. Elec.	£1	33/9		15	15	8 17 9	33/9	27/6
Switchgear & Cowans	5/-	11/6	−3d	22½	10	4 7 0	13/7	9/9
Taylor Tunnicliff	5/-	11/3		25	12½*	5 11 0	12/4	10/7
T.C.C.	10/-	41/3		20	30*	—	41/3	21/3
T.C. & M.	£1	38/9	+1/3	10	8½*	4 7 8	37/6	30/3
Telephone Mfg.	5/-	9/6		10	10	5 5 3	9/6	7/6
Thorn Elec.	5/-	29/6		12½	20	3 7 9	30/6	13/3
Thornycroft	£1	36/6		25	25	—	39/6	26/6
Tube Investments	£1	82/6	+1/3	15	17½	4 5 0	81/3	60/3
Vactric	5/-	24/6		Nil	10	2 0 10	24/6	7/6
Veritys	5/-	9/-		10	12½	6 19 0	10/6	5/-
Walsall Conduits	4/-	52/6		70	70	5 6 8	52/6	44/-
Ward & Goldstone	5/-	42/9	+3d	45	50	—	43/6	21/-
Watford	2/-	6/9		25	22½*	—	7/3	4/7
Westinghouse Brake	£1	82/6xd		16	18	4 7 3	86/3	60/9
West, Allen	5/-	18/-		15	17½	4 17 3	19/6	12/7
Wolf Electric	5/-	16/6		15	17½	5 6 0	17/6	11/-
Trusts, Transport and Communications								
Anglo-Am Tel.:								
A Ord.	100	88		6	6	6 16 4	89½	80
Ord.	100	54½		3¾	3¾	6 17 6	55½	52
Anglo-Portuguese	£1	24/9		—	8	6 9 4	25/9	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	21/6	+1/-	35	50	—	24/-	13/-
Cable & Wireless:								
Ord.	£1	45/-	+3/9	8	9	4 0 0	42/9	26/2
4% Loan	100	98½		4	4½	4 1 3	98½	95½
Calcutta Trams	£1	20/6		2½†	6†	5 17 0†	24/6	17/1
Cape Elec. Trams	£1	17/-		5½	7	8 4 9	17/6	12/4
Marconi Marine	£1	34/-		10	10	5 17 8	35/-	27/6
Oriental Tel. Ord.	£1	101/3		16	16	—	101/3	82/6
Telephone Props.	£1	90/-	+2/6	—	—	—	92/6	74/6
Telephone Rentals	5/-	11/-	+3d	10	10	4 11 0	11/-	9/-

Morphy-Richards

Some erratic movements have affected Morphy-Richards 4s shares since the circulation of rumours to the effect that Great Universal Stores was considering a bid for the control of the company. Morphy - Richards were quick to issue a statement denying knowledge of any impending bid and giving the information that no plans were in being for a change in the status of the company. Having jumped initially from 27s 6d to 31s 3d, the price of the shares reacted part of the way to 29s 6d after the official declaration, which also announced the retirement of Mr. George Wansborough from the chairmanship and the election of Mr. H. D. Drysdale. Morphy-Richards shares put up one of last year's best market performances, rising from the equivalent of 11s to 26s 6d in the course of the twelve months.

Bruce Peebles

The £1 ordinary shares of Bruce Peebles & Co., quoted in Edinburgh, have been marked up further since the chairman's indication of dividend prospects following the share-for-share scrip issue. The present price of 73s 9d, ex the issue, compares with the equivalent of 63s 9d previously. Very few shares are on offer. It is expected, said the chairman, that the company may be able to maintain on the doubled capital the same rate of dividend as before, namely 15 per cent, and, furthermore, to recommend a cash bonus, although this may be at a rate lower than the 10 per cent paid for 1953.

Electrical Apparatus Co.

Shareholders of the Electrical Apparatus Co. now have details of the capital adjustments which will come up for approval at meetings on 26th January. One proposal provides for the merging of the 10 per cent "A" and 8 per cent "B" preference shares into a single 8 per cent issue, holders of the "A" shares to receive, by way of compensation, an additional 8 per cent preference for every four shares held. Ordinary shareholders are to be offered new shares on a one-for-eight basis. These changes were forecast a few months ago, at the time of the final dividend declaration for 1953-54. The latter, making a total annual payment of 22½ per cent, exceeded expectations and was accompanied by notably progressive profit figures. Since then, the price of the 5s ordinary shares, which were introduced to the market at around 12s 6d a year and a half ago, has advanced to about 20s. The yield works out at 5½ per cent.

REPORTS and DIVIDENDS

Burco-W. H. Dean Merger.—It is reported that the board of W. H. Dean & Son, Ltd., has entered into agreements to purchase the whole of the issued share capitals of Henry Slack & Sons, Ltd., G. L. Howarth & Co., Ltd., and Amplec, Ltd., all engaged in the manufacture of domestic washing appliances. An agreement has been reached in principle by the boards of Burco, Ltd., and W. H. Dean & Sons upon a merger of the two companies by the formation of a holding company, and an exchange of shares. It is proposed that the board of the new holding company shall include Mr. D. K. Ward (chairman), Mr. J. Taylor and Mr. L. F. Hiles. The object of the merger is to integrate production facilities with a view to greater efficiency in design, production and distribution. The directors expect to give shareholders of both companies further details of the basis of exchange by the end of this month.

The Electrical Apparatus Co., Ltd.—Details are now announced of the reorganization of the preference capital and the issue of ordinary shares by the capitalization of £31,258 10s. It is proposed to amalgamate the "A" and "B" preference shares into a single class of 8 per cent cumulative preference shares, to reduce the present rate of dividend of 10 per cent on the "A" preference shares to 8 per cent and abolish the premium of 5s on repayment of capital. To compensate for this holders are to receive one 8 per cent preference share for every four "A" preference shares held. Holders of ordinary shares will receive one 5s ordinary share for every eight ordinary shares held. The proposals will be considered at meetings to be held on 26th January.

Pye, Ltd.—The recent offer of 1,000,000 5½ per cent £1 second cumulative preference shares produced applications for a total of approximately 2,400,000 shares. Applications for up to and including 1,000 shares were accepted in full. Larger applications were accepted to the extent of about 33 per cent subject to a minimum of 1,000 shares for each application.

J. & F. Stone Lighting & Radio, Ltd.—Arrangements have been completed for the purchase by the company of Bookers Lighting & Radio which carries on a similar business. The purchase, which adds twenty-one retail stores to the J. & F. Stone organization, will not involve any fresh issue of capital.

Greenwood & Batley, Ltd., have declared an interim dividend of 5 per cent (unchanged).

New Companies

V. F. Howard, Ltd.—Private company. Registered 21st December. Capital £1,000. Electrical and mechanical engineers, electricians, scientific instrument makers, etc. Directors: W. Price and Mrs. Anne Price. Secretary: Anne Price. Registered office: 6, Market Street, Leigh, Lancs.

Hyradar, Ltd.—Registered 18th December. Capital £2,500 in £1 shares. Objects: To carry on the business of manufacturers, distributors, agents, consultants, designers and repairers of electrical apparatus of all kinds, including radio and radar equipment, etc. Directors: R. E. Gordon (secretary) and M. G. Fleet. Regd. office: Grosvenor Mansions, 82, Victoria Street, S.W.1.

Douglas E. Wright, Ltd.—Registered 1st December. Capital £100. Electrical engineers and general electrical installation contractors, radio and television engineers, etc. D. E. Wright is permanent managing director. Regd. office: Empire House, St. Martins-le-Grand, E.C.1.

Paton (Balham), Ltd.—Registered 29th November. Capital £100. Electrical engineers and contractors, electricians, radio engineers, etc. Directors: L. A. Hastilow, Mrs. Ivy E. Hastilow, and N. Paton. Regd. office: 10, Yukon Road, Balham, S.W.12.

Wentworth Electronics Co., Ltd.—Registered 1st December. Capital £100. Radio, electrical, television, public address and recording engineers and dealers in electrical apparatus, etc. I. A. B. Brampton is the first director. Regd. office: 8, Station Approach, Wentworth, Virginia Water, Surrey.

W. J. Turner (Radio), Ltd.—Registered 29th December. Capital £100. Merchants of, agents for and wholesale and retail dealers in radio, television and electrical apparatus, etc. Directors: W. J. Turner (secretary) and J. Ehrlich. Regd. office: 173, High Road, Willesden, N. W. 10.

Increases of Capital

Neosid, Ltd.—Increased by £18,000, in £1 5 per cent non-cumulative preference shares, beyond the registered capital of £2,000.

Aidas Electric, Ltd.—Increased by £49,100, in 1s ordinary shares, beyond the registered capital of £50,900.

Liquidation

Electrical & Radio Installations (Ealing), Ltd.—Last day for receiving proofs for dividend, 18th January. Liquidator, Mr. J. B. Clifford, 4, Bucklersbury, London, E.C.4.

Bankruptcies

C. T. Boden, carrying on business as a wholesale electrical, hardware and fancy goods dealer under the style of the High Peak Wholesale Electrical Supplies at 5, Hartington Street, Derby, and as a retail electrical, hardware and fancy goods dealer at "Anafon," Abergele Road, Old Colwyn, Flint.—Trustee, Mr. R. F. Bendall, 126, Colmore Row, Birmingham, appointed 31st December.

H. Turner, 20, Battersea Rise, Clapham Common, London, carrying on business as a radio and electrical contractor.—Order made 8th December suspending discharge for three months until 8th March.

R. H. Winslade, 7, Collingwood Mount, Portsmouth Road, Camberley, Surrey, electrical engineer.—First and final dividend of 2s 1¾d in the £, payable at 11-12, Finsbury Square, London, E.C.2.

J. H. Trevithick, electrician, partner in the firm of Power, Light & Sound of 51, Fore Street, Callington, Cornwall.—Supplemental dividend of 1 19/20d in the £, payable at 24, Lockyer Street, Plymouth.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to the dates stated:—

22nd January

REDIFON. No. 733,291, Class 9. Coil winding machines, profiling machines, machine tools, electric generators, motors (not for land vehicles) and apparatus for starting such motors; and parts.—Redifon, Ltd., Carlton House, Lower Regent Street, London, S.W.1.

OMNISINT. No. 723,006, Class 9. Electrotechnic apparatus, gauges and electric conduit material.—Salzgitter Maschinen Akt.-Ges., Bod Bundesrepublik, Germany.—Address for service, c/o W. P. Thompson & Co., 12, Church Street, Liverpool, 1.

AUDITEC. No. 733,627, Class 9. Electronic sound detectors for use in industry to trace faults.—Bonochord, Ltd., 48, Welbeck Street, London, W.1.

LYNDOCK. No. 735,411, Class 9. Electric soldering irons.—Lyndock Electrical Products, Ltd., Old Netley Works, Portsmouth Road, Sholing, Southampton.

ELECTRAMAID. No. 735,561, Class 9. Electric suction cleaners and parts.—Vacuum Cleaners & Electrical Supplies, Ltd., 20-22, Gipsy Hill, London, S.E.19.

29th January

CLIPPER. No. 731,639. ZEPHYR. No. 734,487, Class 9. Vacuum cleaning apparatus (electric).—Neptric, Ltd., 73-79, Hurst Street, Birmingham, 5.

KAYCAPS. No. 733,921, Class 9. Electric capacitors (condensers).—A. H. Hunt (Capacitors), Ltd., Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18.

TUNSAN. No. 734,099, Class 9. Electrical and electronic apparatus and instruments; and radio and television sets.—G. F. Faulkner (Export & Import), Ltd., 40, Tonbridge Road, Maidstone, Kent.

DELSTAR. No. 734,214, Class 9. Electrical apparatus.—Stewart Transformers, Ltd., 75, Kilburn Lane, London, W.9.

STANTEC. No. 734,405, Class 9. Electronic calculating apparatus and parts; telecommunication apparatus and instruments; and insulated electric cables.—Standard Telephones & Cables, Ltd., Connaught House, 63, Aldwych, London, W.C.2.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 16th February from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1949

26875. British Communications Corporation, Ltd., and Heftman, T. S.—Frequency changers for radio receivers and the like. 18th January, 1951. (724075.)

31115. M. & C. Switchgear, Ltd., and Richardson, F. B.—Thermal over-current trip device. 6th July, 1951. (723962.)

1950

12344. National Research Development Corporation.—Electronic counting circuits. 15th May, 1951. (724172.)

12411. Brush Electrical Engineering Co., Ltd.—Hand controller for electric vehicles. 18th May, 1951. (724077.)

20430. Compagnie Générale d'Electricité. —Method of and apparatus for charging accumulator batteries. 17th August, 1950. (724175.)

1951

6362. Western Electric Co., Inc.—Space discharge devices employing resonator. 16th March, 1951. (724083.)

7928. Wooldridge, J. L.—Electrically maintained pendulum driven by gravitational impulses from a weight. 4th April, 1952. (723968.)

8076. Peto Scott Electrical Instruments, Ltd., Hill-Venning, J., and Heath, R. C.— Electric relays. 4th July, 1952. (724182.)

8077. Peto Scott Electrical Instruments, Ltd., and Hill-Venning, J.—Balancing of relay armatures and like parts. 4th July, 1952. (724183.)

8265. Ericsson Telephones, Ltd., and Stevens, J. R. H.—Systems of electrical signalling over common lines. 8th July, 1952. (723969.)

9569. Eltgroth, G. V.—Frequency selective networks. 24th April, 1951. (723970.)

10093. Pittsburgh Plate Glass Co.— Articles provided with electro-conductive coatings. 30th April, 1951. (724086.) 10095. Conductive articles. 30th April, 1951. (724087.) 10838. Treatment of electro-conductive films. 8th May, 1951. (724088.)

16856. Sangamo Weston, Ltd.—Arrangements for testing electricity meters. 15th July, 1952. (724093.)

21000 and 21298. Metropolitan-Vickers Electrical Co., Ltd.—Construction of rotors for steam and gas turbines. 5th and 9th September, 1952. (723882/3.)

22929. British Thomson-Houston Co., Ltd.—Magnetization of magnets. 16th September, 1952. (724192.)

24497. General Electric Co., Ltd., and Brook, F.—Electrical devices including hollow tubes adapted to act as waveguides. 20th October, 1952. (724195.)

25022. Southern United Telephone Cables, Ltd.—Method and apparatus for the testing of electric cables. 23rd January, 1953. (723977.)

27285. Maoli, L.—Automatic electric circuit breaker. 21st November, 1951. (724197.)

28236 Mullard Radio Valve Co., Ltd.— Cold cathode valve circuits. 19th November, 1952. (723892.)

29635. Automatic Electric Laboratories, Inc.—Time announcing system. 18th December, 1951. (724278.)

30262. Electric & Musical Industries, Ltd. —Electron-discharge devices. 23rd December, 1952. (723987.)

1952

2266. Electric & Musical Industries, Ltd. —Light absorbent surfaces in electron-discharge devices. 16th January, 1953. (724202.)

2659. Hanovia Chemical & Manufacturing.—Ultra-violet vapour electric discharge lamps. 31st January, 1952. (724105.)

2918. British Thomson-Houston Co., Ltd. —Frequency meters. 27th January, 1953. (723990.)

4651. Trist & Co., Ltd., R.—Photo-electric detecting apparatus. 28th January, 1953. (723905.)

5893. Sylvania Electric Products, Inc.— Devices embodying germanium and the manufacture of such devices. 6th March, 1952. (723996.)

5946. Ferranti, Ltd.—Time-base arrangements. 26th May, 1953. (723909.)

6839. British Thomson-Houston Co., Ltd.—Pulse generating circuits. 25th February, 1953. (723911.)

7122. Associated Electrical Industries, Ltd.—Electronic calculating apparatus. 19th March, 1953. (724209.)

7469. Canadian Benaudi Co., Ltd.— Electrodynamic sound transmitting and receiving units. 24th March, 1952. (724113.)

8022. Telephone Manufacturing Co., Ltd. —Automatic telecommunication exchange systems. 18th March, 1953. (723997.)

9810. British Thomson-Houston Co., Ltd.—Wattless current regulating systems for a.c. circuits. 17th April, 1953. Addition to 629586. (723918.)

10010. Weitkowitz, G.—Method of and apparatus for pressing metal ferrules or sleeves on to the ends of electrical conductors. 21st April, 1952. (724002.)

10955. Electric & Musical Industries, Ltd. —Radio communication apparatus and multiple channel two-way communication channels. 20th April, 1953. (723919.)

12220. British Thomson-Houston Co., Ltd.—Contact rectifiers. 26th February, 1953. (724121.)

12592. Westinghouse Brake & Signal Co., Ltd., and King, K. G.—Code following devices of the magnetic amplifier type for use in coded track circuit signalling systems. 31st March, 1953. (724007.)

13999. Flight Refuelling, Ltd., Brooke-Smith, F., and Macgregor, P. S.—Float-operated electric switches. 26th May, 1953. (724125.)

14235. British Thomson-Houston Co., Ltd.—Ferro-electric ceramic compositions. 5th June, 1952. (724126.)

14304. National Research Development Corporation.—Thermionic valve circuits. 8th June, 1953. (724013.)

14829. Siemens Electric Lamps & Supplies, Ltd.—Circuit arrangements for starting and operating hot-cathode electric discharge lamps. 5th June, 1953. (723932.)

16654. Everett, Edgcumbe & Co., Ltd.— Electrical measuring instruments. 1st May, 1953. Cognate application 27308, 30th October, 1952. (723938.)

18810. Marconi's Wireless Telegraph Co., Ltd.—Pulse controlled oscillator arrangements. 2nd April, 1953. (724282.)

19211. Triangle Products, Ltd.—Portable electric spot welding tools. 5th August, 1953. (724237.)

22933. Licentia Patent-Verwaltungs Ges. —Self-holding electromagnetic relays. 12th September, 1952. (724034.)

22939. Siemens Bros. & Co., Ltd.—Electric circuit arrangements for indicating the occurrence of fault or other abnormal conditions. 11th September, 1953. (724035.)

24761. Merunovich, A.—Unipolar generator. 2nd October, 1952. (724247.)

25618. Sangamo Weston, Ltd.—Electrical indicating systems. 13th October, 1952. (723949.)

26254. General Electric Co.—Methods of forming oxide films on electrodes for electrolytic capacitors. 20th October, 1952. (723950.)

26349. Ferranti, Ltd.—Stabilizing equipment. 20th October, 1953. (723951.)

26989. Fenwal, Inc.—Thermostatic electric switches. 27th October, 1952. (724045.)

30175. Fuller, L., and Sudlow, E. W.— Electrical secondary batteries. 18th November, 1953. (724056.)

32620. British Thomson-Houston Co., Ltd.—Mechanical rectifiers. 20th October, 1953. (724165.)

32729. Whessoe, Ltd.—Electricity supply equipment for electrical precipitation plant. 24th March, 1954. (724068.)

32982. Philips Electrical Industries, Ltd. —Manufacture of cathode-ray tubes. 30th December, 1952. (724167.)

1953

1255. Compagnie Générale d'Electricité. —Electric accumulator charging control elements. 17th August, 1950. Divided out of 724175. (724259.)

5901. Sangamo Weston, Ltd.—Photo-electric controllers. 3rd March, 1953. (724294.)

6274. Standard Telephones & Cables, Ltd.—Circuit element having a negative resistance. 6th March, 1953. (724296.)

6320. Hazeltine Corporation.—Automatic frequency control system for high frequency oscillation generators. 6th March, 1953. (724297.)

6844. Farbenfabriken Bayer Akt.-Ges.— Electrolytic cell. 12th March, 1953. (723958.)

7781. General Electric Co.—Electrical heating of irradiated specimens. 20th March, 1953. (724309.)

8153. Reutter, J. L.—Armatures for electromagnetically operated devices. 24th March, 1953. (724312.)

8572. Sangamo Weston, Ltd.—Construction of indicating or measuring instruments. 27th March, 1953. (724323.)

8573. Cox, D. B.—Electrical conductors. 27th March, 1953. (724324.)

8677. Willard Storage Battery Co.— Primary electric battery. 30th March, 1953. (724327.)

8889. Western Electric Co., Inc.—Transposed electric conductors. 31st March, 1953. (724332.)

10016. General Electric Co.—Electrical power systems. 13th April, 1953. (724335.)

10176. Sumitomo Electric Industries, Ltd. —High frequency electric conductor. 14th April, 1953. (724337.)

12759. O'Neill, A. E.—Manufacture of mineral insulated metal sheathed electric cables. 14th July, 1953. (724346.)

13693. Metropolitan - Vickers Electrical Co., Ltd.—Thermal protective devices for electromagnetic apparatus. 15th May, 1953. Addition to 707262. (724351.)

15009. British Thomson-Houston Co., Ltd.—Arc furnace control systems. 29th May, 1953. Addition to 640633. (724357.)

16623. Eaton, M.—Electrode boilers. 16th June, 1953. Addition to 682658. (724359.)

17955. General Electric Co.—Fused capacitors. 29th June, 1953. (724362.)

21204. Soc. Anon. de Telecommunications.—Multiple channel carrier current telephone cable. 30th July, 1953. (724368.)

21258. Electric Storage Battery Co.— Electric storage battery plates. 31st July, 1953. (724369.)

22285. Elektrokemisk Aktieselskap.—Contact arrangements for the anodes of electrolytic furnaces for aluminium production. 12th August, 1953. (724371.)

25731. General Electric Co.—Clothes-drying machines. 17th September, 1953. (724376.)

30663. General Electric Co.—Dynamo-electric machines. 5th November, 1953. (724389.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—14th February. Electricity Commission of New South Wales. Six 11/12 kV auto transformers. (E.S.B. 30155/54. Ten/12059.)*

Bath.—21st January. City Council. Electrical installations in three pairs of houses at Claverton Down and two terraces of seven dwellings on the Foxhill estate. Architect, 7, North Parade Buildings.

Denbighshire.—County Council. Electrical installation in new secondary school at Holt Road, Wrexham. (See this issue.)

Edinburgh.—North of Scotland Hydro-Electric Board. 11 kV and auxiliary power cables for Ceannacroc power station. (See this issue.)

Egypt.—15th February. Factories Directorate, Ministry of War, Cairo. Insulated cables and accessories. (E.S.B. 30193/54. Ten/12072.)* L.v. sub-distribution boards. (E.S.B. 30192/54. Ten/12075.)*

France.—20th April. Ministère de l'Air Service de l'Infrastructure, Paris. Electrical distribution network and ground lighting at Orleans-Bricy airfield. (E.S.B. 19477/54. Ten/12088.)*

India.—31st January. Madras Electricity Department. Lightning arrestors. (E.S.B. 30167/54. Ten/12044.)*

17th February. Madhya Pradesh Electricity Board, Nagpur. Line materials. (E.S.B. 30048/54. Ten/12069.)*

Iraq.—Directorate General of Municipalities, Bagdad. 31st January. 100 kW a.c. generating set. (E.S.B. 29320/54. Ten/11879.)* 12th February. One 150 kW alternator set. (E.S.B. 30044/54. Ten/12026.)* 14th February. 150 kW d.c. generating set. (E.S.B. 29319/54. Ten/11876.)* Two 50 kW d.c. generating sets. (E.S.B. 29318/54. Ten/11877.)* 15th February. 100 kW d.c. generating set. (E.S.B. 29371/54. Ten/11878.)* 16th February. One 400 kW alternator set. (E.S.B. 30027/54. Ten/12023.)* 19th February. One 500 kW alternator set. (E.S.B. 30026/54. Ten/12022.)* 21st February. Two 100 kW diesel electric generating sets. (E.S.B. 33/55. Ten/12094.)* 23rd February. Two 50 kW alternator sets. (E.S.B. 30028/54. Ten/12024.)* 26th February. One 100 kW and one 50 kW diesel electric generating sets. (E.S.B. 35/55. Ten/12096.)*

New Zealand.—29th March. State Hydro-Electric Department, Wellington. 33 kV outdoor switchgear. (E.S.B. 30181 and 30229/54. Ten/12074 and 12080.)*

Pakistan.—20th January. Posts and Telegraphs Department, Karachi. Voltage regulators. (E.S.B. 30238/54. Ten/12084.)* Three facsimile trans-receivers. (E.S.B. 30175/54. Ten/12079.)* 29th January. Aerial cables. (E.S.B. 30240/54. Ten/12085.)*

Persia.—31st January. Razieh Water and Power Co., Tehran. Two 250 kW diesel generators. (E.S.B. 30276/54. Ten/12086.)*

Seaton Valley (Northumberland).—22nd January. U.D.C. Electrical installations in 21 bungalows at New Hartley. Surveyor, Council Offices, Seaton Delaval.

South Africa.—2nd February. Stores Department, South African Railways, Johannesburg. H.r.c. switchboards. (E.S.B. 30108/54. Ten/12053.)* One high potential testing set for testing 3,000 V d.c. traction motors, control equipment and general h.v. testing. (E.S.B. 30106/54. Ten/12063.)*

14th February. Durban Corporation. Telephone cable and terminal assemblies. (E.S.B. 29865/54. Ten/12007.)*

Stockport.—26th February. Corporation. Electrical laboratory equipment for Stockport College. (See this issue.)

Thailand.—8th February. Royal Irrigation Department, Pakret, Nondhaburi. Electrical distribution equipment and cables. (E.S.B. 29992/54. Ten/11997.)*

United States.—20th January. Bureau of Reclamation, Denver, Colorado. Five 115 kV circuit breakers. (E.S.B. 29921/54. Ten/12029.)*

Uruguay.—16th February. Usinas Electricas y los Telefonos del Estado, Montevideo. Telephone equipment. (E.S.B. 30201/54. Ten/12093.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Glasgow.—Municipal Transport Committee. Lead covered cable (£7,881).—Scottish Cables.

Maidstone.—Housing Committee. Recommended. Electrical wiring of 88 houses, Shepway estate (£1,970.)—North Electrical & Refrigeration Co.

Newcastle-on-Tyne.—Tyne Improvement Commission. Twelve months' supplies of electrical materials.—Hackbridge Cable Co., Ltd. (electric cable); Hardy and Hogg (electric lamps); Samuel Gratrix, Ltd. (electric lamps).

Reading.—Corporation. Electrical installations in 103 pre-war Council houses on various housing estates (£1,545).—H. Morgan.

Thornaby-on-Tees.—Town Council. Electrical installations in eighty-six houses being erected by direct labour on the Gilpin Brown housing estate.—A. R. Hunt.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Annfield Plain.—Large factory additions for Ransome and Marles Ball Bearings Co.; J. H. Napper, architect, Eldon Place, Newcastle-on-Tyne.

Atherton.—Houses (44) and 40 flats, Hag Fold estate; U.D.C. surveyor.

Bath.—Modernization and reinstatement of the Royal National Hospital for Rheumatic Diseases; South Western Regional Hospital Board, Parklands, Tyndalls Park Road, Bristol, 8.

Beckenham.—Office block; Percy Jones (Twinlock), Ltd., Elmers End.

Birtley.—School at Elizabethville; county architect, Durham.

Bolton.—Administrative block and workshops, Manchester Road; Edward Bullough, Ltd., radio and electrical engineers, 31, Knowsley Street.

Boston.—Indoor swimming baths for Town Council; borough surveyor.

Brandon.—Houses (49), at Ushaw Moor for the U.D.C.; direct labour.

Brighton.—Factory, Lower Bevendean area; L. & G. Godfrey, Ltd., 78, Church Road, London, W.3.

Chippenham.—Block of offices in Foundry Lane; Wiltshire Bacon Co., Ltd., Royal Wilts Bacon Factory.

Cockermouth.—Houses (86), Oughterside and Broughton Moor brickworks site; A. E. Simpson, R.D.C. surveyor.

Corby.—Primary school, Exeter estate, and secondary modern school, Hazel Leys; county architect, Northampton.

Coventry.—Omnibus garage, Leicester Street; Midland Red Motor Omnibus Co., Ltd., Bearwood, Smethwick, Birmingham.

Churches at Willenhall, Henley Green and Tile Hill; Basil Spence & Partners, architects, 48, Queen Anne Street, London, W.1.

Ealing.—Departmental stores on site at the Broadway, W.13; British Home Stores, Ltd., 129, Marylebone Road, London, N.W.1.

Exeter.—Police headquarters, ambulance buildings, courts, etc., on the Gladstone Road/Heavitree Road site (£180,000); J. Brierley, city surveyor, 7, Southernhay West.

Felling (Co. Durham).—Combined swimming baths and community centre; U.D.C. surveyor.

Great Yarmouth.—Factory, Caister Road; D. & F. McCarthy, Ltd., 58, Market Place.

Hull.—Secretarial school, Paragon Street; Sir Isaac Pitman & Sons, Ltd., Southampton Row, London, W.C.1.

Construction of a block of offices adjoining Cross House (£50,000); Dickinson, Miller and Turnbull, solicitors for the promoters, Cross House Buildings

Kettering.—Houses (330), Pytchley Road estate; borough architect.

Ketton (Rutland).—Houses (42), Ryhall; W. J. Hemmings, architect, Broad Street, Stamford, Lincs.

Kidderminster.—Works extensions; T. & A. Naylor, Ltd., Green Street.

Kingsbury.—Works extensions; Injections Moulders, Ltd., Westmoreland Road.

Leeds.—Old people's hostel, Acre Close, Middleton; city architect.

Leyland.—Research wing at Farington for Leyland Motors, Ltd.; Harry S. Fairhurst & Son, architects, 55, Brown Street, Manchester.

Liverpool.—Factory, Kirkby trading estate; Kraft Foods, Ltd., Hayes, Middx.

Lytham St. Annes.—Dwellings (144), Smithy Lane site; borough surveyor.

Macclesfield.—Factory at the North Eastern industrial estate for Rochdale Carpet Co., Ltd.

Manchester.—New building at Oxford Road, for University of Manchester; J. W. Beaumont & Sons, architects, Danlee Buildings, Spring Gardens, Manchester.

Newcastle-on-Tyne.—Factory for Smith's Potato Crisps, Ltd.; Beard, Bennett and Wilkin, architects, 101, Baker Street, London, W.1.

Northampton.—Reconstruction of the public baths; borough architect.

Scunthorpe.—Junior school, Rochdale Road; Gollins, Melvin & Partners, architects, 15, Manchester Square, London, W.1.

Sheffield.—Cinema, Flat Street and Norfolk Street, for J. Arthur Rank Organization; Harry W. Weedon & Partners, architects, 45, Calthorpe Road, Birmingham.

Southport.—First portion of scheme for mental deficiency colony at Greaves Hall (£670,044), for Liverpool Regional Hospital Board; Lloyd & Cross, building contractors, Argyle Street, Birkenhead.

Stratford-on-Avon.—Factory in Masons Road; Peak Engineers, Ltd., New Street.

Swindon.—Two factories on industrial estate; J. Ackroyd, borough surveyor, Civic Offices.

Walthamstow.—Secondary technical school; Tooley & Foster, architects, Midland Bank Chambers, Buckhurst Hill.

Winton.—Factory on site at Wallisdown; Loewy Engineering Co., Ltd., Branksome Grange, Lindsay Road, Westbourne, Bournemouth.